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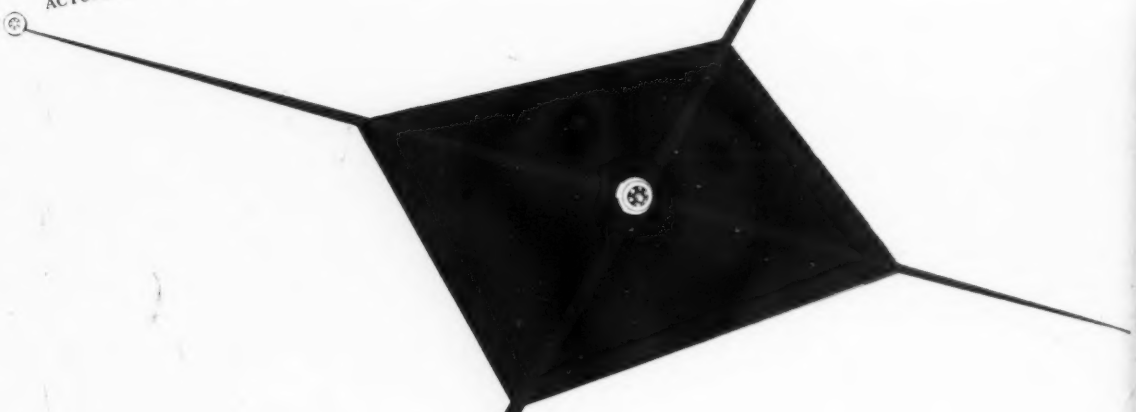

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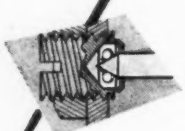

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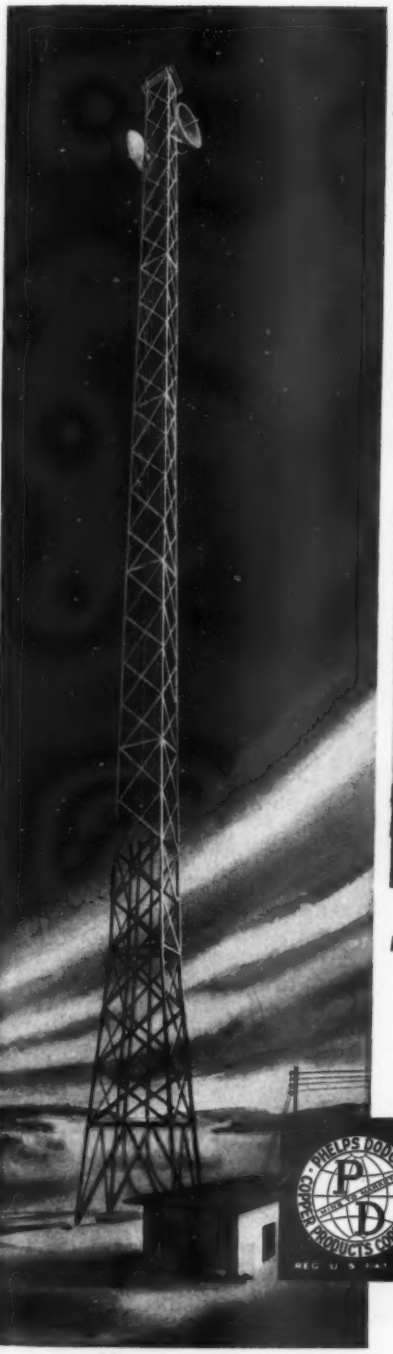

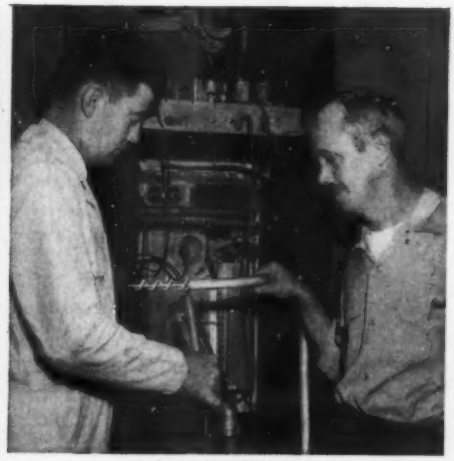

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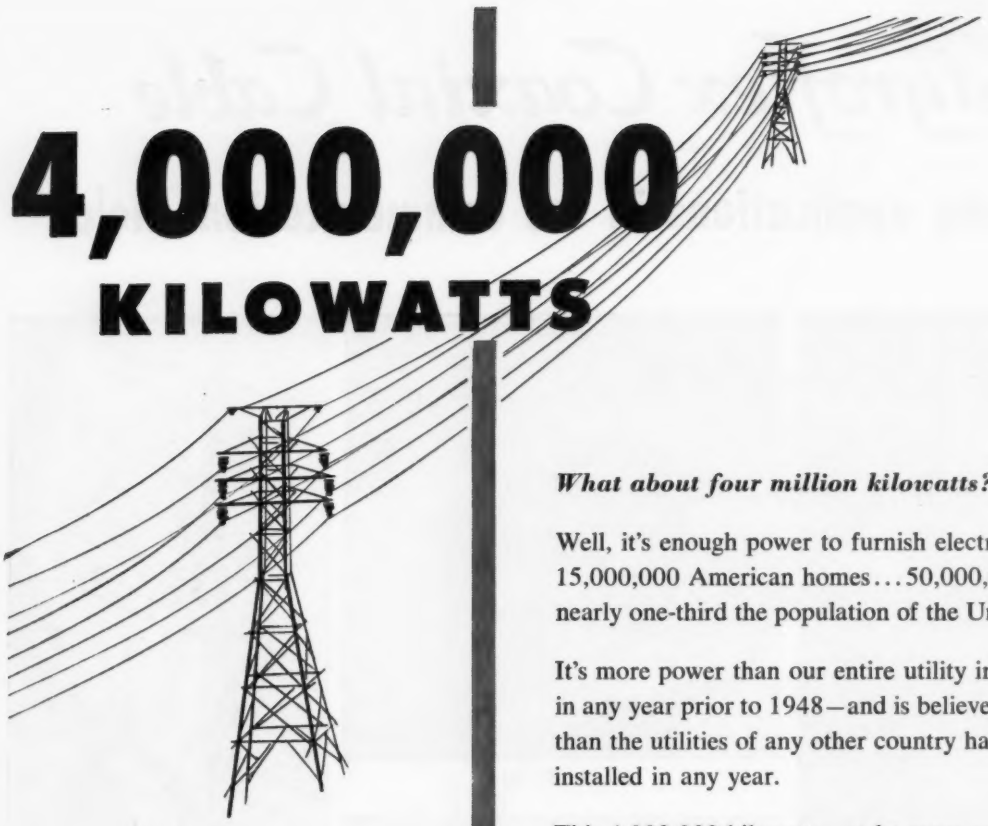
# 4,000,000 KILOWATTS



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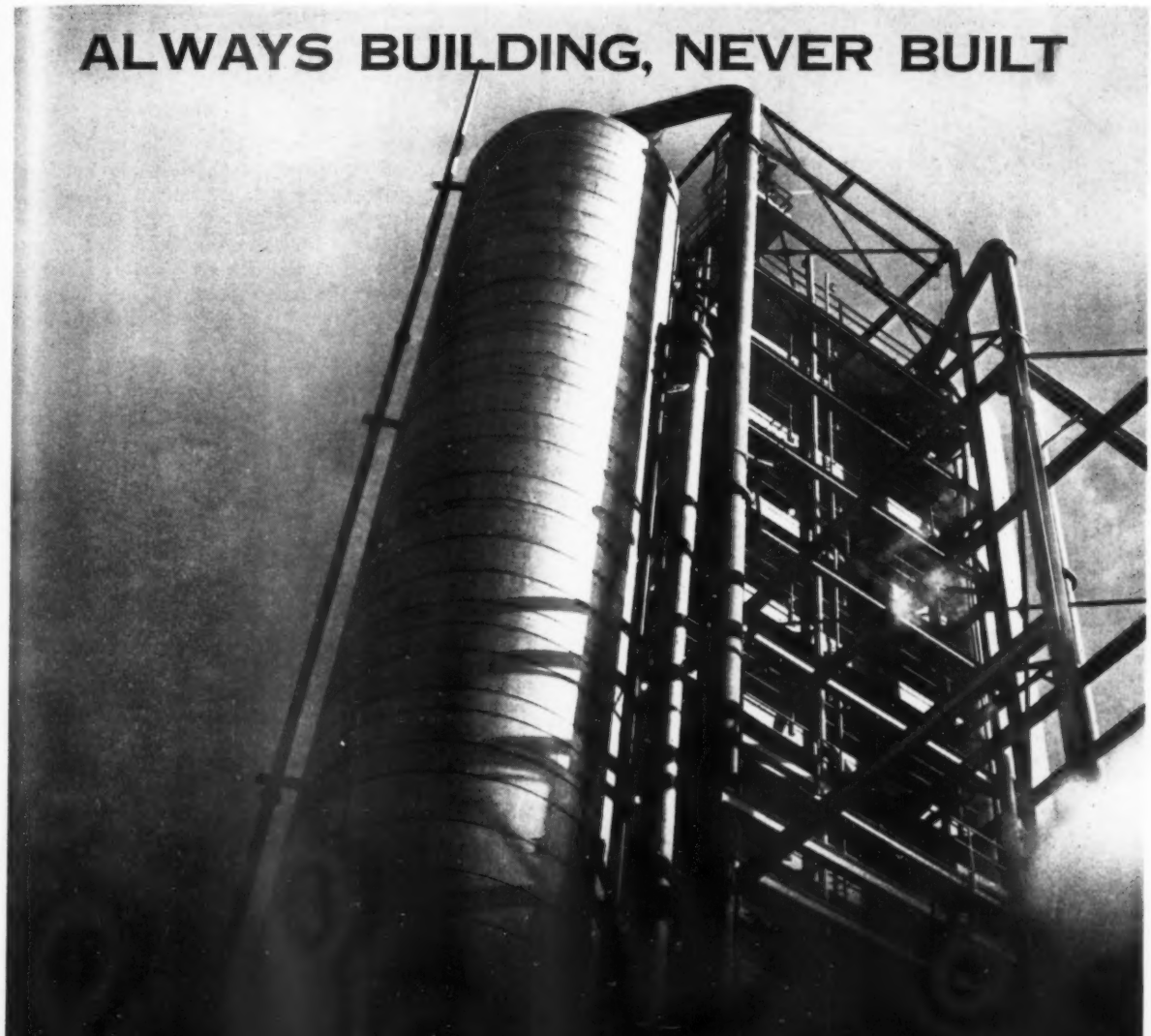

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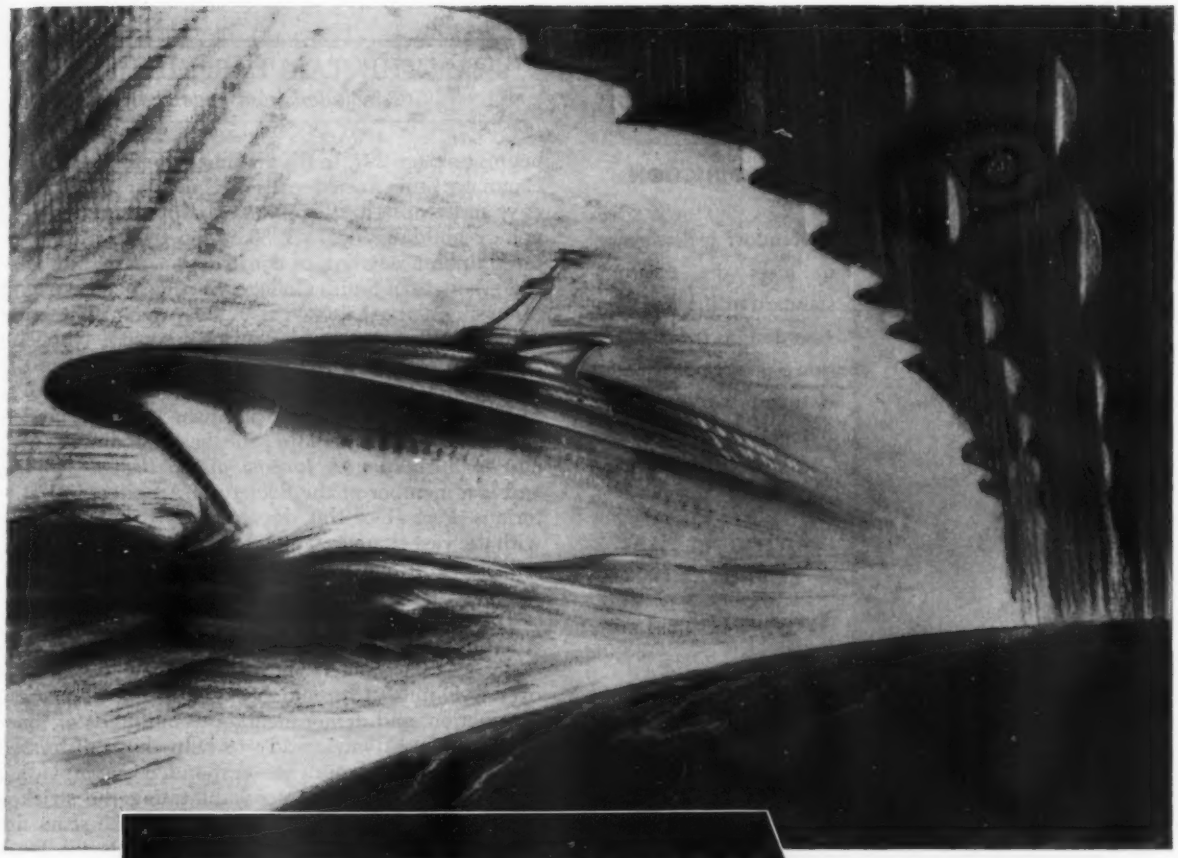
# THE TABULAR VIEW

**Radio Pioneer.** — Probably no man has made more significant contributions to progress in radio communication than Major Edwin H. Armstrong whose discovery of regeneration (1914), the superheterodyne receiver (1918), super-regeneration (1922), and noise-free, frequency-modulation transmission (1936) has truly revolutionized "wireless." Certainly no man was a more determined example of rugged individualism than this radio pioneer whose brilliant and controversial career came to an abrupt end on January 31. EDWARD L. BOWLES, '22, for many years Professor of Electrical Communications and now Consulting Professor of Industrial Management at M.I.T., was personally well acquainted with "the Major" for several decades, and records his tribute to a former friend (page 292). As published in this issue of The Review, Dr. Bowles's address was originally broadcast over Station WGBH, the frequency modulation station of the Lowell Institute Co-operative Broadcasting Council. Professor Bowles's broadcast was not only transmitted via the system of frequency-modulation which the Major had devised, but was sent on its way by means of a transmitter which Armstrong had built and donated to educational activities in this area.

**Atmospheric Pollution.** — By pouring soot, smoke, fumes, and other gases into the fresh air which we breathe, man has made a major contribution to atmospheric pollution. Although the extent of such pollution tends to increase as society becomes more completely industrialized, it is possible to take steps to keep foreign substances under control. Such measures are discussed (page 294) by HAROLD BAVLEY, engineer for the Division of Occupational Hygiene, Massachusetts Department of Labor and Industries. Since 1935, when he received the B.S. degree in chemical engineering from Northeastern University, Mr. Bavley has worked in the field of industrial hygiene and safety. Since 1946 he has been in charge of engineering activities of the Massachusetts Division of Occupational Hygiene. He is a registered professional engineer, and has contributed numerous articles to the literature, including one on Ionizing Radiation which appeared in the June, 1953, Review.

**Technology's Architecture.** — Throughout its eight and one-half decades of education in architecture, science, and engineering, the Institute has had three different homes. The original one in the Mercantile Library Building on Summer Street in Boston saw the birth of M.I.T. and served it but a few years. The home on Boylston Street witnessed the growth of the Institute through its adolescent era, and the Institute has grown to vigorous manhood since moving to its site in Cambridge. In each of its three locations, M.I.T. buildings were marked by different, and characteristic, architecture. The story of Technology's architecture is traced from the beginning in 1865 to the present time in a two-part article, of which Part I

(*Concluded on page* 286)



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begins on page 297. In the first installment, the author, CAROLINE SHILLABER, recalls the splendor of an earlier day, and emphasizes architectural progress in Technology buildings up to 1938, when the Institute entered upon a new era of construction. Miss Shillaber is a graduate of Smith College. She has been assistant librarian in the Library of Landscape Architecture and City Planning at Harvard University. Not long ago, however, Miss Shillaber became librarian of the Arthur Rotch Memorial Library of Architecture at M.I.T. from which vantage point she has documented Technology's architecture. She has contributed articles to *Speculum, A Journal of Mediaeval Studies*, and is a member of the Society of Architectural Historians. Part II of this documentary article, dealing with the vast changes which have occurred since 1938, will appear in the May issue of The Review.

**Tornado Tragedy.** — Less than a week before Alumni Day, 1953, central Massachusetts was suddenly struck by a vicious tornado that wrought havoc over a 40-mile strip, and brought death, desolation, destruction, and demoralization to hundreds of innocent victims. Always ready to help those distressed by emergency, Americans responded in providing temporary shelter and in rehabilitating the stricken region. Today, less than a year later, the scars are healed and a story of magnificent co-operation is revealed (page 303) by WALTER C. VOSS, '32. Joining the M.I.T. Faculty in 1928, he became head of the Department of Building Engineering and Construction in 1940, and served in that position until his retirement in 1953. This post fitted him admirably for the responsibility of serving as consultant to the Worcester Housing Authority which assumed major responsibility for the program of rehabilitation. To a long and distinguished career in the field of building construction, Professor Voss adds new laurels by serving the Institute this year as special lecturer.

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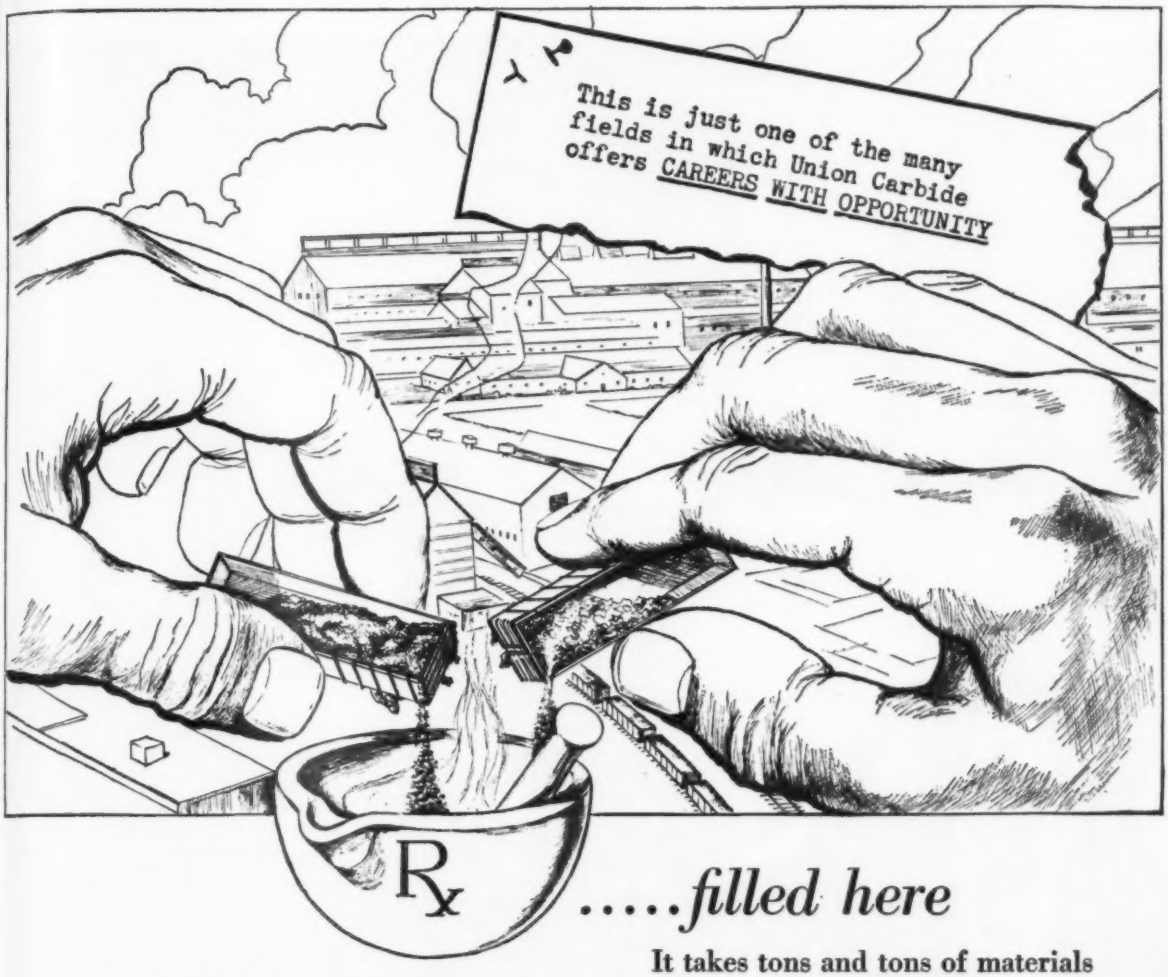


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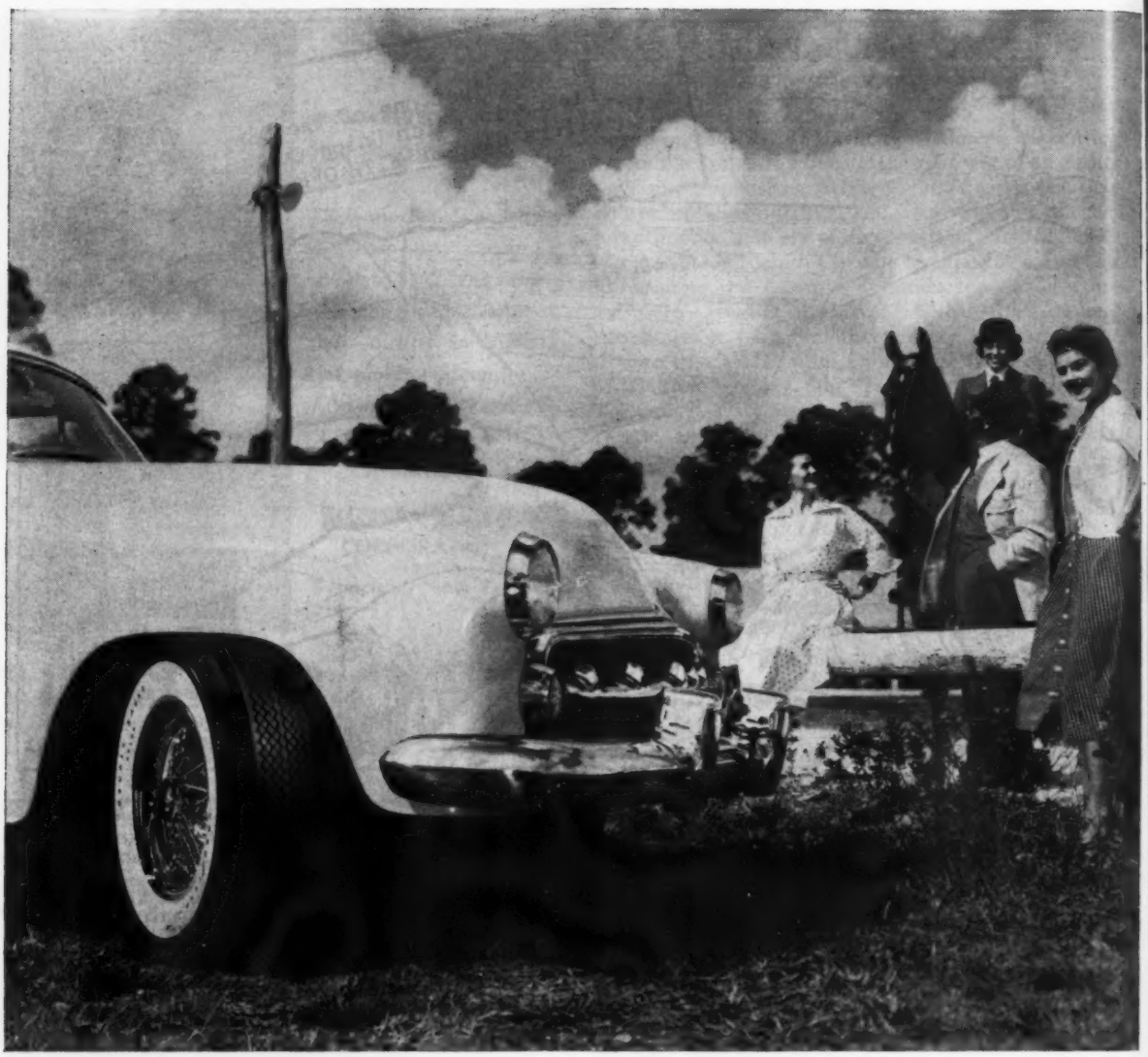

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*Statue of Leif Ericson (March Contents page) has been erected in Boston on Commonwealth Avenue, at Charlesgate East, near Kenmore Square. The statue by Anne Whitney is about three quarters of a mile from M.I.T. and overlooks the Back Bay Fens.*

Raymond E. Hanson

***How Well Do You Know Boston?*** *This exquisite architectural detail from an earlier period of Boston's history has probably been passed by every Technology Alumnus. Can you identify, and locate, this well-displayed doorway? If not, see Contents page for next month.*


# THE TECHNOLOGY REVIEW

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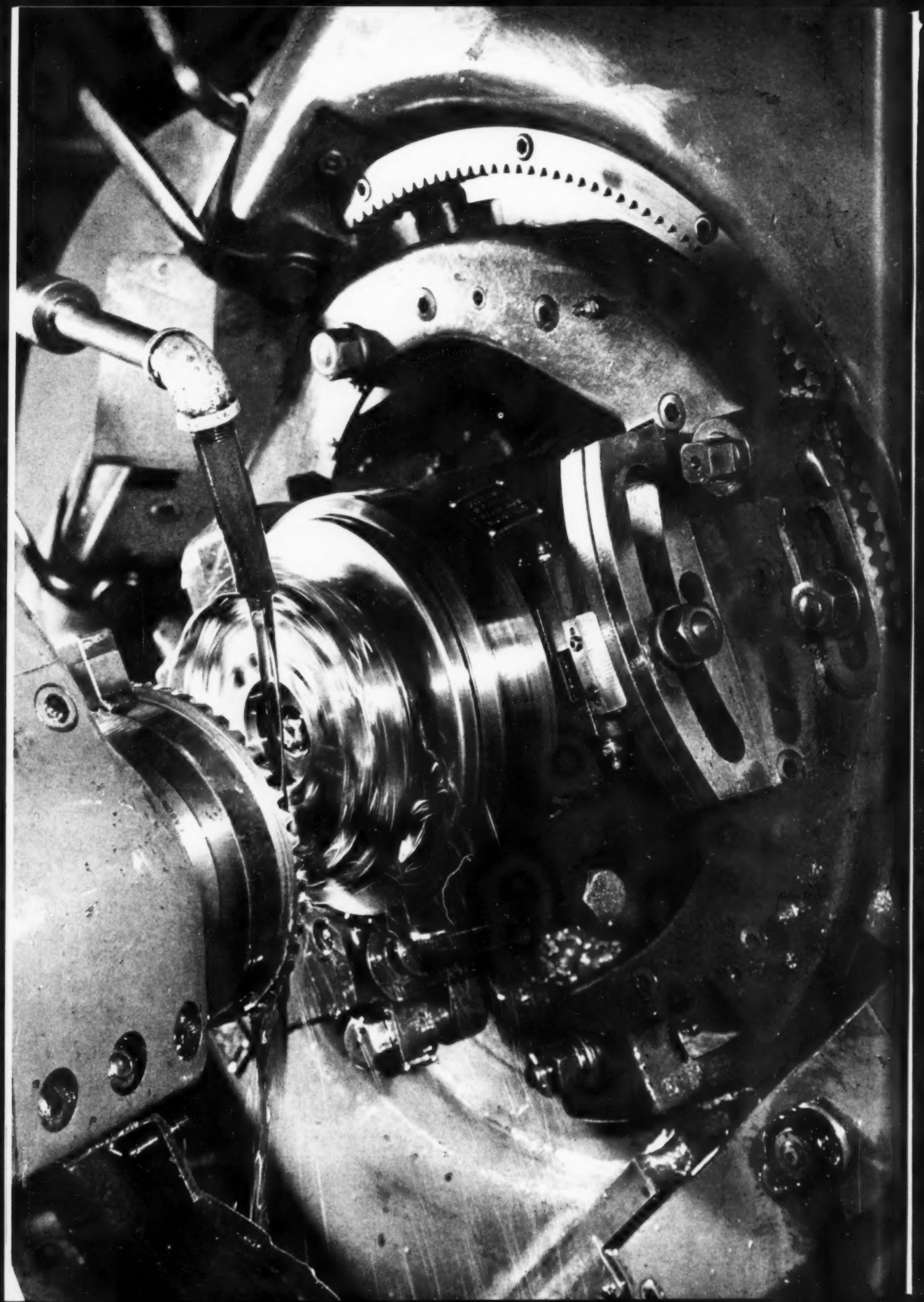


THE
TECHNOLOGY
REVIEW

Vol. 56, No. 6 April, 1954

# The Trend of Affairs

## *TV Counts Blood Cells*

THE television camera has been turned into the eye of a simple and ingenious computer to count microscopic particles such as blood cells, bacterial cultures, or grains of photographic emulsion. The system, known in its laboratory stage as the Sanguinometer, was developed by a team of electronics engineers at the David Sarnoff Research Center of the Radio Corporation of America in Princeton, N.J., working in close co-operation with the Sloan-Kettering Institute, research unit of the Memorial Center for Cancer and Allied Diseases, in New York.

The equipment was devised to provide a simple, rapid, and accurate mass method of taking blood counts to detect the first signs of radiation sickness among persons in the target area of an atomic bomb. A blood count is an important indicator in many diseases and in those circumstances where anemia may be a complication, such as overexposure to radiation which may occur during atomic attacks.

In addition to this possible emergency use, its application is foreseen in hospitals and research centers to perform almost instantaneously and with a minimum of error a process that has long been a laborious and often unprecise manual operation.

The Sanguinometer is essentially a closed-circuit industrial television system combined with an optical microscope and a novel computer that has the ability to make a count of particles in a given field by means of a unique electronic circuit. The television camera, substituting for the eye of the observer at the eyepiece of the microscope, feeds the information it "sees" to both the computer and a monitor viewing screen, used in the developmental version to help in focusing and illuminating the microscopic specimen.

In operation, the camera tube of the Sanguinometer, scanning the specimen under the microscope, sends out video pulses as the scanning beam strikes the images of the particles to be counted, and the pulses in turn actuate an electronic counter. As in all television processes, the beam scans its field of vision from side to side, progressing downward in a series of parallel lines. The lines are so close together that in a normal microscopic magnification each particle to be counted interrupts several lines as the scanning beam moves across the field, and consequently produces several pulses in the output of the television system. Normally large particles will interrupt more lines and produce more pulses individually than will small ones, and the counter would be unable to distinguish between a large number of small particles or a small number of large ones.

This obstacle was overcome by an ingenious diameter compensation circuit that is able to determine the average size of the particles by taking account of a direct relationship between the average time duration of the pulses and the diameter of the particles. This indicates the number of video pulses created by each particle, a figure electronically fed to the counter where it divides the total number of pulses to give an automatic reading of the actual number of particles.

The entire process, as performed by the latest laboratory model is both simple and far more rapid than any manual count. Once the slide is prepared and put under the miscrosope, the operator manipulates a single control knob on the counting meter until an electric eye tube on the meter case is closed. With compensation for the average diameter of the particles, the operator reads the meter to determine blood count.

During laboratory tests employing microscopic blood specimens, an operator with the Sanguinometer was able to make several counts of red cells in various regions of the specimen and to average the results before a technician operating without the equipment could complete a single count.

◄ ***Cutting Machine***
*A study in modern metal processing, by David W. Corson from A. Devaney, Inc. N.Y.*

## *Major Edwin H. Armstrong**

### *By* Edward L. Bowles

I HAVE been asked to broadcast in memory of Major Armstrong. I was reluctant. I could not recoil from the great shock of his sudden death. Major Armstrong was a close friend and one with whom I have been privileged to work professionally. I had followed his career for years. I had come to regard him as one of the greatest creative minds the field of electrical communications has ever known.

Major Armstrong was a humble man who enjoyed a humble beginning. The outstanding feature of his boyhood home in Yonkers was his attic room. He was a radio amateur – a member of that considerable global fraternity which by its experimentation in informal radio-communication, through code and voice, has contributed much, not simply to technology but to good fellowship and mutual understanding.

When yet a student at Columbia, Armstrong discovered what is known as the regenerative circuit – the vacuum tube oscillator – now a commonplace in all radio transmitters and in receivers. This device literally revolutionized radio communication. During World War I, as an officer in the Signal Corps, he made many original contributions, the most outstanding of which was the superheterodyne circuit. Today no radio receiver would be complete without this device. There followed the super-regenerative receiver – a discovery based on a phenomenon Armstrong observed in his Columbia Laboratory before the war, the explanation of which had occupied his mind during the intervening period. One of the all-time great contributions, and one perhaps better known by the public, is his contribution of modern FM radio. This invention is predicated on a concept which had been held alien among our most noted communications authorities and proved impossible by at least one of the world's leading mathematical minds. Here was Armstrong at his best, as a man of great faith, faith that the application of one's talents can surmount man's pre-disposition to resist progress and fall victim to dogma. To prove his point to a skeptical world, this man had finally to erect his own transmitter: the tower at Alpine, N.J., today stands as a symbol of his determination and his faith.

The application of FM communication to the needs of our armed forces and its use in the landing operations of the Marines demonstrated the outstanding superiority of this form of communications in tactical military operations.

Each of Armstrong's contributions was of a profound epochal character. How few men there are in any professional field who can match his persistent, systematic method and quality of discovery. Despite the fullness of his life of invention, so important were his contributions that he was never free from the plague and harassment of patent litigation. He was, however, never deflected from his research, nor was he deflected from an interest in humanity at large and in what radio could contribute to its enjoyment, enlightenment, and well-being.

The very station over which this tragic message is being broadcast owes much to Major Armstrong's generosity. He donated the transmitter at Great Blue Hill.

In the current evolution of business, homage is paid to the concept of organized research. This type of activity is often thought of as the modern substitute for old-time individual entrepreneurial effort. The imposing list of brilliant, inventive achievements of Armstrong, made on his own and without the benefit of vast staffs and massive facilities, confirms one's faith in the enduring place of the individual creative genius.

It is not often that man is gifted so far beyond the ordinary that he is destined to be immortalized by his own achievements. What can be nobler than a life's work which gives constant inspiration to others as it unfolds mysteries and by its own hands opens them as things understood and things significant.

How can one ask more of a man than that he shall be of great integrity, fighting for that in which he honestly believes, and fighting relentlessly when it is to establish a principle which has been violated or abused, thereby to contribute to a better world.

All this and more may be said of Major Armstrong, the price for whose courage in life and devotion to a cause was untimely death.

*Text of an address given by Professor Bowles over WGBH, the frequency modulation station of the Lowell Institute Cooperative Broadcasting Council, on the occasion of the untimely death (on February 1) of a radio pioneer and outstanding contributor to radio science.

## *Ouch!*

THE millions of Americans who daily swallow innumerable aspirin tablets – to combat "morning headache" and such contemporary ills promulgated so convincingly by radio announcers and other advertising media – would be startled to know that some of the best objective methods available for evaluating pain-relieving effect of drugs do not demonstrate the analgesic powers of aspirin. This fact is often cited by students of *dolorimetry* (the quantitative study of pain) but this is not to deny the pain-relieving efficacy of aspirin; such efficacy is acknowledged to be categorically established by long, practical experience. The relationship is cited, rather, to emphasize the pitfalls of pain-study methods.

Dolorimetry is beset by at least one general difficulty applying to all quantitative biological studies, and by at least four unique difficulties. In pain response, as in all characteristics, human beings show a wide range of variability. Hence in pain studies, as in all quantitative physiological research, single observations are meaningless. Substantial numbers of subjects must be used in any test; results must be interpreted by means of the specialized techniques of mathematical statistics.

Experimental difficulties unique to human pain studies include the totally subjective nature of pain, the impossibility of using animals as subjects, the fact that "placebos" (inert materials) have definite pain-relieving effectiveness, and the possible multiple nature of pain.

Pain is purely subjective, is manifest only as a symptom. Hence the doctor must take at face value whatever his patient tells about the presence or intensity of pain; there is no objective clinical sign for

pain verification. It is obvious, then, that quantification of pain – whether it hurts a little or a lot, or how today's pain compares with yesterday's pain – is highly approximate.

These observations point to another special obstacle in pain studies, the impossibility of using experimental animals. The veterinary is said to have a harder job than the physician because the animal patient cannot say where it hurts. Animals may be used as readily as human beings to study drugs producing effects that can be objectively measured; for example, variations in pulse rate or in blood pressure. In pain studies, animals are relatively useless because there is no objective measure of pain.

An intriguing difficulty in pain studies is the extraordinary phenomenon of placebo reactors. A placebo (pluh-*see*-bo) is an inert substance administered in the guise of a drug to a patient who thinks he is receiving a potent medication. Placebos have had a place in medicine through the ages. Their effectiveness is not limited to psychosomatic ills; placebo reactors are not necessarily malingerers or neurotics. Indeed placebos are known to bring dramatic relief to some people suffering pain from extensive tissue injury, as in a wound or a major surgical operation. Hence studies of pain relief by drugs must be done by testing in parallel a placebo, an analgesic drug of known potency, and the drug whose analgesic properties are being assessed.

Finally, pain studies are complicated by doubt as to whether pain may be regarded as a unitary phenomenon. Thus the effect of drugs on pain response is sometimes studied with normal human subjects by exposing the skin, as on the forearm, to heat until a sensation of pain is noted. Do findings made in this way apply to pain from extensive tissue damage as in surgery? Or to the agonies of childbirth, where pain arises from spasms in involuntary muscle?

Much excellent research is now fast converting dolorimetry into an exact science. Outstanding studies are being done at the Massachusetts General Hospital. An example of the refinements in technique established by the latter studies is proof of the necessity of keeping the experimenter, as well as the subject, in the dark about the identity of placebo, standard drug of known potency, and new drug being tested. It was discovered that no matter how scientifically disinterested the experimenter may be, results are distorted if he knows what he is working with. Therefore, it is necessary to have all test substances coded by someone having no direct contact with the experimental work.

Recent advances in dolorimetry are welcomed because they facilitate discovery and evaluation of improved pain-relieving drugs. The new methods are also enabling re-evaluation of standard drugs, whose usage is based solely on practical trial and error. Thus the standard dose of morphine was established at 15 milligrams on the basis of centuries of trial and error (employing crude opium in the early days). But new studies, employing the methods of modern dolorimetry, have shown that half as much morphine—eight milligrams—actually gives maximum pain relief. In short, half of the world's supply of this valuable drug has been wasted through the centuries.

## *Whaling a la Mode*

THE pursuit of the whale is taking an increasingly technical turn. Time was when the main requirements were a brawny arm, a good eye, a harpoon, and a 25-foot whaleboat. Today, when the number of whales taken yearly is many times that in the historical heyday of whaling just before the Civil War, the American invention of a mother ship and a swarm of whaleboats operating as a group is still the pattern. A few small innovations, however, have been added. The iron-tipped harpoon has been replaced by an explosive missile fired from a small cannon; the mother (or factory) ship has grown to be one of the largest types of merchant ships built, with facilities for dragging the entire whale aboard and extracting the oil not only from its blubber but also from its bones and meat; and the whaleboats, now called killer boats or whale catchers, would put some submarine chasers to shame, although during World War II those who manned these underwater denizens felt they were operating a product highly representative of the technology of the Twentieth Century.

An example of the modern whale catcher is the *Enern*, largest of the 230 such ships of various designs now serving European whaling fleets. With a length of 210 feet, a gross tonnage of 908 tons, and a propulsion plant of 2,700 horsepower, this ship can pursue a whale at 17 knots, and recently completed a record run from antarctic waters to her home port in Norway in 21 days, 17 hours – after killing 245 whales during her first season. (These figures will bear comparison with the first trip of the *Charles W. Morgan* which took three years, three months, and twenty-four days. Fifty-three sperm and eight right whales were caught.) Navigating equipment includes gyro-compass and radar. Another feature is a variable pitch propeller which can be operated remotely from several positions on the ship. One such station is the gunner's platform, far out on the bow. It may be of interest that the gunner and captain alone share separate cabins. In the old days the harpooners were a cut below the mates in rank.

Apparently there is enough parallel between hunting for whales and hunting for submarines to merit the use of two modern devices which have proved their worth in antisubmarine work. These are sonar and the helicopter. The value of the helicopter in searching for whales, which can be seen from the air at considerable depths, as well as when blowing, is obvious. As for the sonar, a British firm has adapted that instrument to whaling requirements, so that the whale, once located, can be tracked in range and bearing, and will less frequently outguess the gunner. Range scales up to 2,000 yards (about one nautical mile) are provided. At least 11 whale catchers are now equipped with sonar.

Another refinement borrowed from naval warfare is the radio transmitting marker buoy. Since it is reported that 10 per cent of all whales killed are lost before the factory ship can recover them, the marking of a killed whale is, as it has always been, a serious problem. The new marker buoy, built of lightweight alloys, contains an automatic radio transmitter or beacon with a range of about 30 miles and battery capacity for about three days of operation.

# SOME ASPECTS AND INCIDENTS OF

# Atmospheric Pollution

By HAROLD BAVLEY

THE importance of atmospheric pollution has been greatly augmented due to recent surveys and legislation propounded by some of the larger towns and cities in the United States. The public interest has become intense because of the tragedy which occurred in Donora, Pa. Similar occurrences have been reported from time to time in various industrialized areas of our country, but it seems that only with the occurrence of the several fatalities in the Donora episode has the public become truly conscious of the problem and the inevitable results when atmospheric contamination by toxic fumes, gases, or smoke, is neglected or regarded with little concern. However, the subject is an ancient one, probably dating as far back as the Middle Ages. It has been recorded that Queen Eleanor, wife of Henry III, was obliged to leave the town of Nottingham due to the unpleasant fumes arising from the burning of sea coal. The burning of sea coal was prohibited in London in 1273 as being prejudicial to human health.

John Evelyn, the English diarist, in his pamphlet entitled "Fumifugium" published in 1661, refers in no measured terms to the effects of coal smoke in the city of London: "That This Glorious and Ancient City — should wrap her stately head in Clouds of Smoake and Sulphur, so full of Stink and Darkness, I deplore with Just Indignation."

It may seem that as man became more proficient in production and built his huge industrial plants, the concentration of foreign substances in the atmosphere increased. Unfortunately, a mistaken idea that smoke stacks pouring forth their clouds of Stygian darkness show a sign of prosperity and progress still persists. During a recent survey of a smoke and soot nuisance complaint in a city located in the Connecticut River Valley, an official of that city stated when advised of the purpose of the survey that, "Smoke in the air over a city is a sign of industry, and if one should find a smokeless industrial city, it would be a 'dead city,' a city without industry, a city in the throes of depression." However, the public, particularly the working public, has become conscious of improved conditions at their places of toil, and have revolted against the formerly accepted standard of polluted atmosphere as a necessary evil. Plant owners and many public servants now feel that it is not necessary to pollute the atmosphere outside the plants by smoke, dust, and fume. They have realized that it is a sign of inefficiency and waste to allow smoke and soot (a sign of poor combustion and a waste of power), dust and fumes (which may be salvaged), to escape from the various plant discharge outlets into the atmosphere breathed by the public. The public has begun to complain and rightly so; for the undesirability of a polluted atmosphere from a health, social, and financial point of view is not debatable.

The community "cost" of a pollution nuisance is real and specific. Atmospheric pollution, particularly by smoke and soot, has been found to lower resistance to diseases, to lower vitality, and to increase sickness and the need for medical attention. Dr. I. H. Alexander, Director of Public Health, Pittsburgh, Pa., basing his remarks on statistics relative to pneumonia, has stated that: "It is without doubt the most important factor contributing to the high pneumonia mortality rate in industrial cities." The medical and scientific director of the American Cancer Society, Dr. Charles S. Cameron, recently listed smoke pollution as one of the factors that may favor the development of cancer. In the *Smoke Abatement* bulletins published by the Mellon Institute, Pittsburgh, smoke is accused of "stealing" sunlight. The bulletin further states:

> The smoke from factories and domestic fires, by filling the atmosphere with opaque clouds of smoke and by inducing mists and fogs, deprives the city dwellers of the luminous vitalizing, cheering, health giving, germicidal rays of the sun.
>
> The dark smoke strata of our cities intercept the bactericidal rays of the sun. These rays either check the growth of, or completely exterminate various kinds of pathogenic bacteria. Their deadly effect on the tubercle bacillus is universally recognized.*

A study by the United States Public Health Service of the decrease of light caused by smoke was made in the lower end of Manhattan in January, 1927. On sunny days it was found that there was a reduction of 42 per cent in the amount of daylight at eight o'clock in the morning, and of 18 per cent at noon.

Thus atmospheric pollution becomes a public health problem and must be considered to be of great concern to any community that would conserve the vital efficiency and protect the inhabitants' health.

An appeal to the local authorities that the atmospheric pollution by smoke, dust, or fumes may affect the health of the citizenry is not always welcomed by those holding political offices. However, as was previously indicated, atmospheric pollution is not only of medical concern, but a most important economical aspect is involved. The polluting agent is not only harmful to plant and animal life but may be a nuisance and damage our buildings, causing increased cost for cleaning, painting, and refinishing of building exteriors; it is destructive of real estate values and has started the migration of city dwellers into the suburbs; it depreciates merchandise; it increases soap, laundry, and dry cleaning bills in the home, in addition to marked depreciation of interior furnishings,

* Please see references at end of article, page 316.

thus increasing household living costs. It increases the amount, and therefore, the cost, of illumination used in the home and in business.

Professor Philip Drinker of the Harvard School of Public Health has defined atmospheric pollution as an unusual concentration of any substance in the atmosphere. These substances may be either solid, finely divided particulate matter, such as smoke, soot, cinder, fly ash, dust and pollen, or gases and mists not usually found in the normal atmosphere. Even though nature by attrition, disintegration and other phenomena, such as volcanic eruptions, dust storms, and the formation of fogs and mists, is guilty of atmospheric pollution, nevertheless man-made contamination is probably of greater significance and more easily subject to control. This latter source should be attacked first.

The belching stacks of industrial plants, locomotives, and docked ships spew forth contaminants that pollute the atmosphere. The smoking chimneys of dwellings, apartments, and public and commercial buildings also contribute their share. Of all the substances that are dispersed in the atmosphere, smoke from the combustion of coal, while not the most toxic, certainly is the most abundant and is the major source of complaint by the public.

When any fuel is burned, combustion products must be formed. If the combustion is not perfect, minute particles or solids, called soot, carried in the combustion products, make these visible. With some coals the ash becomes a powder and under certain conditions of fuel bed and draft, the ash may be drawn through the stack and when emitted will be visible. The term "smoke" is applied to combustion products that carry visible solid matter. As the solid matter increases, the density increases until the smoke becomes an opaque dark cloud. The public's primary concern is with the soot. Soot is a mechanical mixture of fine particles of unburned carbon, tars, ash, and frequently sulfur and other compounds. The tar which the soot contains causes the soot to become a sticky mixture.

The smoke nuisance is caused primarily by bituminous coal, which contains volatile matter. This volatile matter passes off as a condensable vapor when the coal is heated. Different bituminous coals vary widely in the amount of volatile matter they carry. A low volatile bituminous coal is available on the market and should be used whenever practical. Massachusetts is known as a "hard coal state," as far as domestic heating is concerned, but the many diversified industries in the Commonwealth use greater quantities of bituminous coal for plant heating and processing than they use of the liquid or gaseous fuels. However, it is believed that more oil and gas will be used in the future if the use of these newcomers becomes economically feasible or if the threat of coal shortages continues.

The primary cause of atmospheric pollution by coal smoke is the failure to secure a sufficient amount of air intimately mixed at the proper temperature for the correct time interval with the combustible gases that are given off by the burning fuel. The secondary cause is carelessness, ignorance, and indifference in the firing and operating of fuel-burning equipment. Using a fuel suited to the equipment, keeping the equipment in good condition, firing carefully and intelligently and using automatic fuel-burning equipment wherever possible should aid materially in reducing the amount of smoke emanating from the stacks. The control of smoke at its source is an economic necessity, for fuel costs must be figured as part of the production cost. It is part of the overhead. Improved combustion of coal will result not only in the control of the smoke nuisance, but also result in the efficient use of a commodity that may become "scarce" without notice

Unfortunately, smoke, soot, and the other products of poor coal combustion have no particular salvage value. Therefore, all efforts must be directed to prevent generation and dispersion of these substances.

Although coal smoke is the most prevalent of atmospheric contaminants, other dusts, fumes, and gases may also be indicted as substances causing pollution. Foundries, chemical plants, and dusty industries in general may pollute the air with process effluents which may have either toxic or nuisance properties. It is indeed fortunate that in most cases the concentrations of toxic contaminants discharged from some of our plants are so quickly reduced by dilution in the surrounding atmosphere that no immediate danger exists. Most complaints by the public are due to the nuisance created by the discharged matter. However, the literature is replete with incidents in which the public has been injured or poisoned by toxic materials from industrial plants.

The episode now called the "Donora Disaster" occurred during the latter part of September, 1948, when heavy smoke and fog settled over this small industrial city located in Pennsylvania's Monongahela Valley. Lack of air movement plus the continuous discharge of fine particulate matter, gases, and fumes into the atmosphere by the industrial plants in this area, contributed to the density of the smog. After two or three days, the atmosphere had become so contaminated that a large section of the populace, particularly those suffering from cardiac and asthmatic conditions, were affected. Nineteen of these sufferers died, and 500 to 600 more were treated by local physicians and hospitals. The State Department of Health, the United States Bureau of Mines, and the United States Public Health Service, immediately dispatched investigators to the affected areas to determine the cause of the atmospheric pollution. Preliminary reports indicted sulfur dioxide, sulfur trioxide, and fluorine as probable indirect causes of the catastrophe. Subsequently, the Division of Industrial Hygiene of the U.S. Public Health Service, at the request of the state government, management, and labor, conducted a detailed investigation of the nature and causes of the contaminants, the probable long-range effects, and methods for controlling future atmospheric pollution in this valley. The results of this study have been published.

Similarly, in the latter part of 1930, a thick fog of unknown origin blanketed a good portion of the Meuse Valley in Belgium. More than 60 people died after a short acute respiratory illness of three or four days. Many head of cattle died or had to be slaughtered. When the fog disappeared on the sixth

day, the respiratory trouble went with it. Hydrogen fluoride and other fluorine compounds, emanating from industrial stacks, plus a particular set of meteorological conditions, have been blamed for this catastrophe. Another investigation seems to indicate that these deaths were due to sulfur dioxide gas. The Meuse Valley incident received widespread publicity because of its dramatic suddenness and the imaginative theories expressed in the newspapers connecting it with a possible hidden supply of war gases.

Only a few years ago neighbors of a plant engaged in handling beryllium compounds have allegedly contracted chemical compounds from the beryllium dust.

The Division of Occupational Hygiene was requested by the Health Department of the City of Boston to investigate a complaint wherein the occupants of a multi-tenanted building complained that ether vaporizing during the cleaning operation involved in the manufacture of white shoes caused headaches and nausea. The cleaning operation was being conducted adjacent to the stair well, so that there was a tendency for the diluted ether-air mixture to travel upward within the building, resulting in the easy detection of the odor. It is doubtful that the actual ether concentration was toxic. However, the psychological effect was apparent. This same shoe manufacturer had only recently relocated this operation, which was formerly situated near the windows fronting on a school, after the school authorities had complained that the ether vapors had caused illness among the school children and teachers. Installation of a wall fan afforded improved ventilation, and the vapors were exhausted to the outdoors. The tenants ceased their complaints after the simple improvement was made.

A Worcester plant engaged in the manufacture of chrome-plated metal furniture occupied the basement of a three-story building. A tool manufacturing plant was located on the upper floors. A heavy concentration of chromic acid mist was discharged from the plating operation to the outdoors. The discharge duct ended directly below the windows of the tool manufacturer. Very little wind was needed to blow the diluted chromic acid mist into the plant whenever the windows were open. The employees of the tool company complained of nasal and throat irritation, while the plant management avowed that damage was being done to the machines and product. On the recommendation of the Division of Occupational Hygiene, the discharge duct was extended well above the roof of the building and weather-capped.

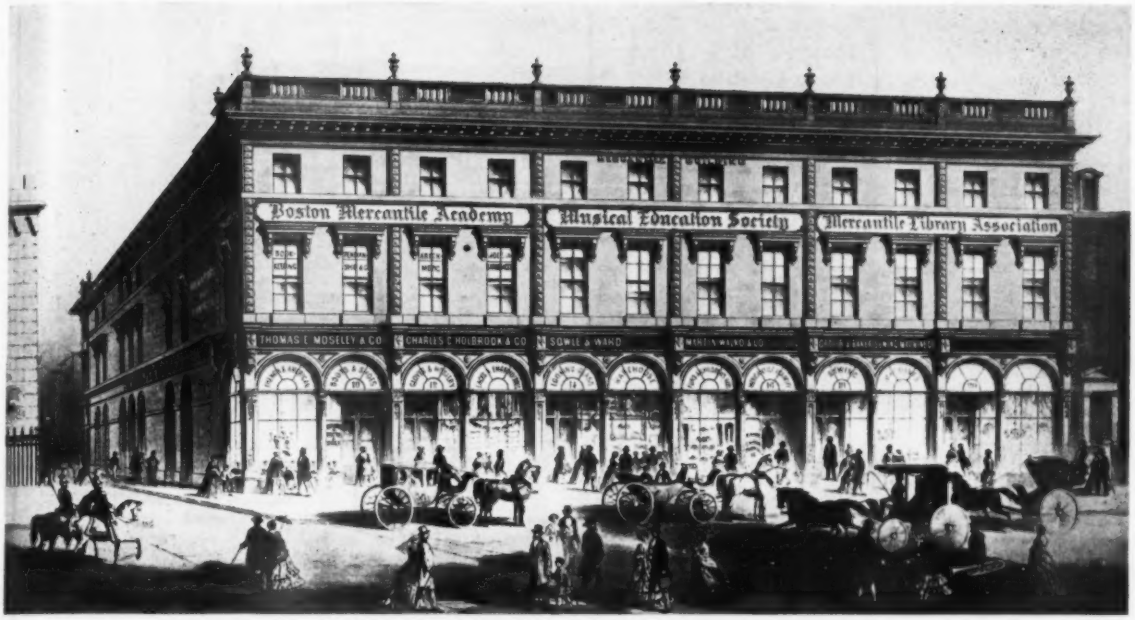
A Salem plant asked our advice on the elimination of atmospheric contamination by hydrochloric acid and nitrous oxide fumes discharged from a metal-cleaning operation. Neighbors, as well as the plant employees working in an adjoining building, had complained of the irritating effect of this effluent. The plant management was very co-operative in eliminating the cause for complaint. At present the exhausted mixture from the metal cleaning booths passes through a water and caustic washing system. The discharge duct has been elevated to 10 feet above the roof of the adjoining building. There have been no further complaints.

While such incidents as the Meuse Valley disaster are more spectacular and receive more publicity, the greatest number of complaints have to do with the "nuisance" created by substances that pollute the atmosphere. Nuisance has been defined as an offensive, annoying, unpleasant or obnoxious thing or practice. Certainly the pollution of the air we breathe by substances such as smoke, dust, and gases and the resulting annoyance and unpleasantness might classify atmospheric contamination as a nuisance.

A survey in which the Division of Occupational Hygiene of the Department of Labor and Industries, and the Division of Sanitary Engineering of the Department of Public Health co-operated, was conducted as a result of complaints by neighbors of a rock wool manufacturing plant located near Pittsfield. On investigation, it was found that tons of fine rock wool were being discharged from the plant and showered down upon several houses and the land located within a half mile radius of the company. Large quantities of light dust were emanating from the top of the blow chamber of the blast furnace. The plant management realized that not only was the nuisance complaint justified, but that a large volume of valuable product was being lost. At a meeting of the Board of Directors, it was decided to appropriate $10,000 for a dust-collecting system.

A group of irate neighbors petitioned the Mayor and the Health Agent of the City of Chicopee to investigate and eliminate the smoke and dust nuisance with which they had been afflicted. The purpose of the investigation was to determine the nature of the nuisance dust, the place of origin, and the means necessary to prevent the nuisance. Samples of the dust were obtained at the homes of the complainants and studied chemically, microscopically, and by x-ray diffraction in our laboratory. It was concluded that dust from a coal yard and passing trains, and soot from undetermined sources contributed to the nuisance. A company located in the vicinity using graphite and charcoal in the manufacture of foundry facing compounds was found not to be incriminated. Chicopee is located across the river from Holyoke, a highly industrialized city. It appeared that in addition to the smoke and soot being discharged from the industrial stacks in Chicopee, considerable smoke could be seen emanating from the industrial power plants along the Holyoke side of the river. These Holyoke plants were believed to be contributing to the atmospheric pollution complained of by the people of Chicopee, since the prevailing wind would normally carry the smoke across the river from Holyoke to Chicopee. Since this was a problem that affected more than a single community, it was proposed that the officials of the cities of Chicopee and Holyoke and the surrounding towns that were affected hold a conference to discuss this problem. Following this, if all agreed to the seriousness of the problem, proper legislative action could be taken to promote a smoke abatement program, similar to that which has been adopted by Metropolitan Boston. Approximately 30 towns and cities are represented on a commission which is headed by a qualified engineer. A single commission could be formed by the cities and towns in the Southern

(*Continued on page 310*)




*The first classes of M.I.T. were held in the old Mercantile Library Building at 16 Summer Street, Boston, from February, 1865, until the fall of 1866. The Mercantile Library was destroyed by fire in 1872.*

# Architecture of M.I.T. Buildings

***Since the Civil War, Trends in American Architecture Have Been Reflected in the Form and Structure of the Institute's Educational Buildings***

**By CAROLINE SHILLABER**

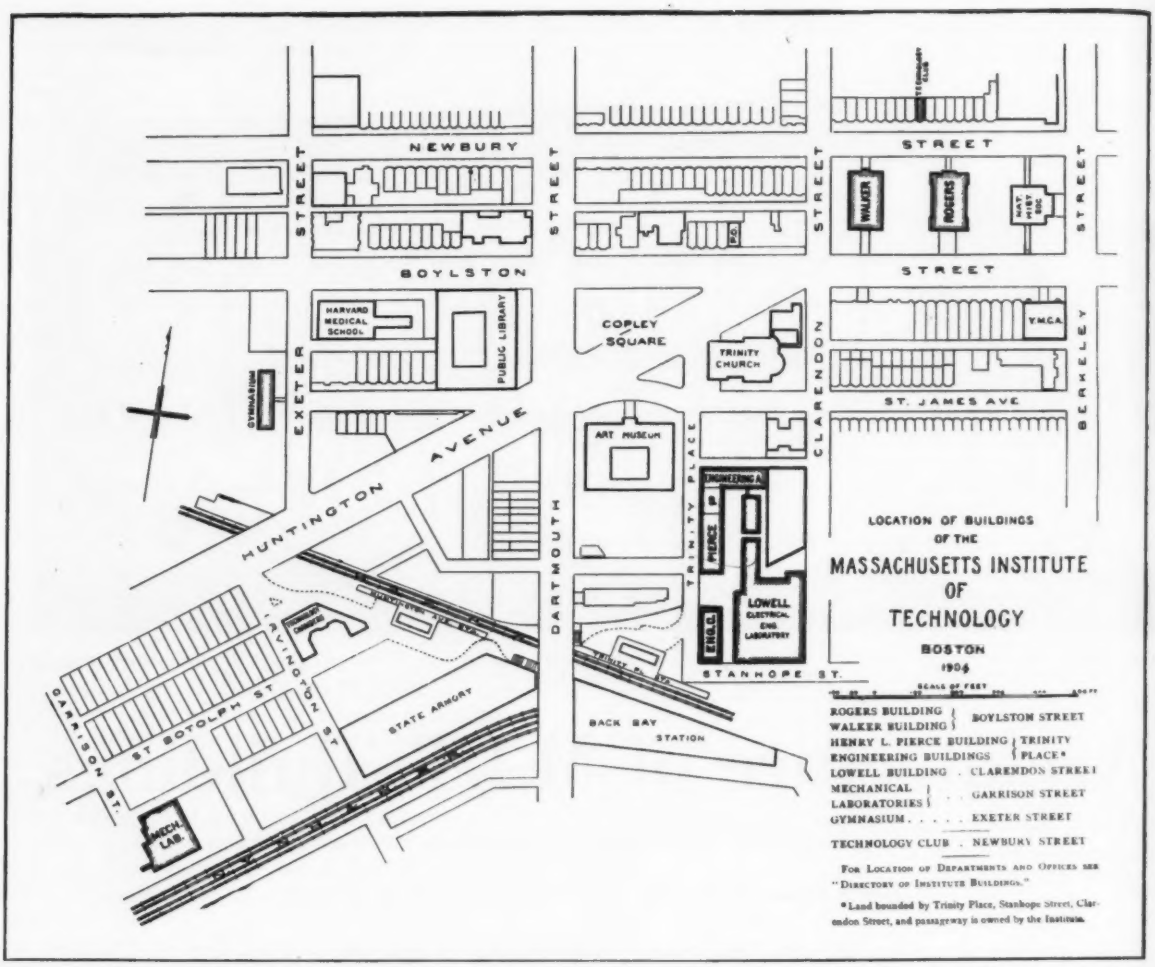
## Part I

WITHIN the long tradition of classic architecture and the wide scope of modern taste, M.I.T. has built approximately 100 buildings dedicated to learning and to research. In the history of its buildings is reflected the development of M.I.T. that, in the years of its growth, paced the progress of America from 1861 to the present time.

When the Institute was granted its charter by the Commonwealth of Massachusetts on April 10, 1861, the United States was a nation of 34 states on the brink of a civil war. In fact, Fort Sumter was fired upon just four days after M.I.T. received its charter. Less than three years earlier the first message had been sent (August 17, 1858) between England and the United States by transatlantic cable shortly before Darwin's *Origin of the Species* appeared in print. The first oil well to be drilled in America was begun at Titusville, Pa., on August 28, 1859. In 1861, George F. Blake invented the water meter and Oliver Wendell Holmes is credited with having devised the stereoscope. Rapid strides in transportation and communication were being made with networks of telegraph and railroad lines crossing the nation, and locomotives traveled at 15 miles per hour.

Although the United States was about to be transformed from an agricultural to an industrial nation by the application of science, the field of technical study was still unexplored in the colleges and universities. The importance of applying science and engineering to the development of industry was recognized, however, by William Barton Rogers, founder of M.I.T., who determined to establish the Institute with three branches: a Society of Arts, a School of Industrial Science, and a Museum of Technology.

The Society of Arts came into existence first with headquarters in the old Mercantile Library Building at 16 Summer Street in Boston. In February, 1865, the School of Industrial Science held its first classes in the same building, classes that inaugurated the phenomenal development from a school of 15 students to a complex organization geared to teaching and research at all levels of modern industry. A fire destroyed the Mercantile Library in 1872, but a tablet (actually placed around the corner on Hawley Street) marks



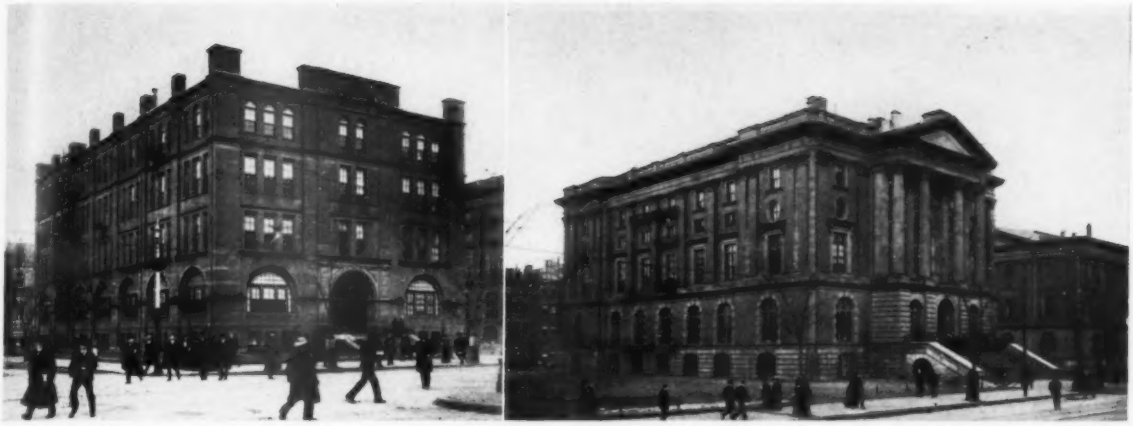

*Between 1866 and 1903 the Institute built and used a group of buildings (shown above with outlines shaded) in Boston's Back Bay area.*

the birthplace of M.I.T. While the birthplace possessed no architectural distinction it happened to be one of the many buildings designed by Gridley J. F. Bryant who had one of the largest architectural practices of his time.

In the fall of 1866, the Institute moved into its own quarters on Boylston Street, the Rogers Building. This was a handsome structure for its day designed by the architectural firm of Jonathan and William G. Preston, and not unlike the adjacent Museum of Natural History which has survived with its exterior little changed as the fashionable store of Bonwit Teller. Rogers presented a belated and somewhat stilted appearance of the Greek revival style that had flourished in Philadelphia, New York, and Boston before the Civil War. From the Rogers Building 14 students were graduated in 1868.

*When M.I.T. was known as "Boston Tech" its presidents occupied this imposing office, devoid of desk telephones.*

Succeeding classes increased steadily in size and a one-story building was put up beside Rogers in 1876 with laboratories reserved for the use of young ladies who had first secured admission in 1871 with the acceptance of Ellen Swallow, a Vassar graduate, as a student in chemistry. She was graduated from M.I.T. in 1873, married Professor Robert H. Richards, '68, and in 1876 was appointed instructor in the Women's Laboratory as the building was called. Fortunately, it did not long survive under the scornful name but was torn down, together with shops that had been erected on the corner of Boylston and Clarendon streets, to make way for a new building in 1883, Walker, named for General Francis Amasa Walker, Third President of M.I.T. Although lacking the archi-



*Walker Building* (left) *built in 1883, and the original Rogers Building* (right) *built in 1866, were the hub of the Institute's academic life. Bearing a somewhat stilted appearance of the Greek revival style, Rogers was used by the Department of Architecture until 1938.*

*The six-story building illustrated above comprised Engineering A* (left), *Engineering B* (center), *and the Henry L. Pierce Building* (right) *built in 1889, 1892, and 1898, respectively. The three-story structure at the left is Engineering C, built in 1903. The Rogers Advanced Laboratory of Physics* (left) *and the library in Rogers Building* (right) *are shown below.*

*An aerial photograph of the M.I.T. buildings along the Charles River in Cambridge. Taken about 1936, this view shows the status of the Cambridge campus at the beginning of what may be termed the modern era in the Institute's architecture.*

tectural elegance of Rogers, Walker was approximately the same size and included special rooms for the use of women students provided by funds raised largely through the efforts of Mrs. Richards. Rogers and Walker, together with a gymnasium on Exeter Street and shops on Garrison, were soon outgrown and a series of buildings was begun on Trinity Place.

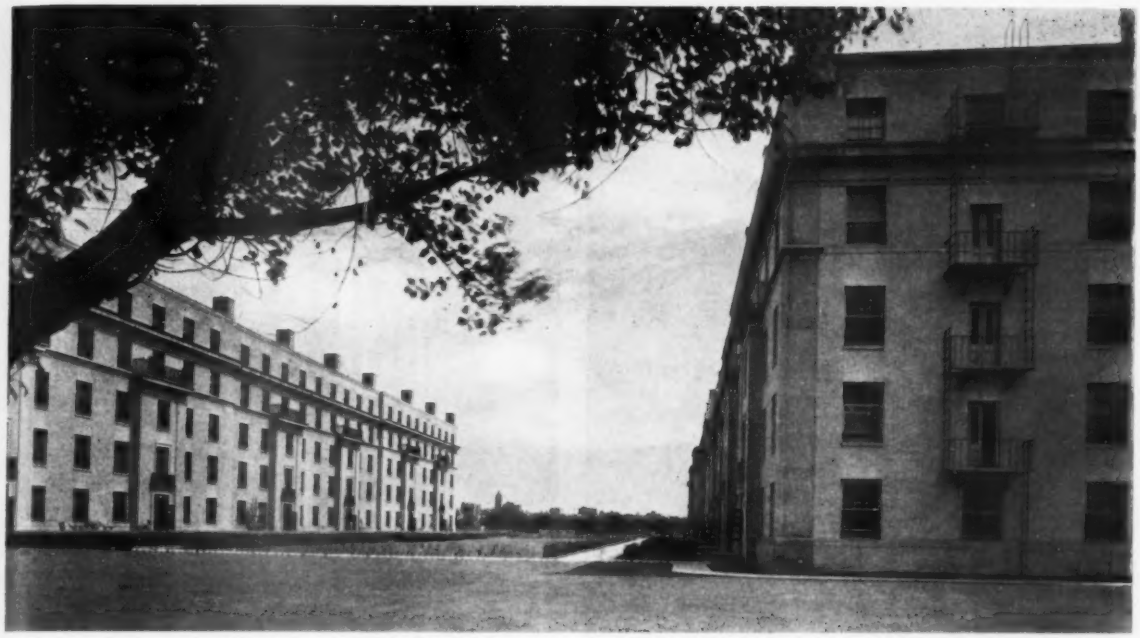
These buildings were known as Engineering A, B, and C, built in 1889, 1892, and 1903, respectively. Professor Francis W. Chandler was architect of A and B, and Rand and Skinner (Theodore H. Skinner, '92) of C. Engineering B was planned originally for the Department of Architecture but the latter moved into the Henry L. Pierce Building (Professor Eleazer B. Homer, '85, architect) when it was constructed in 1898. In 1902, the Department of Electrical Engineering was transferred from Walker Building to the Augustus Lowell Laboratory (Rand and Skinner, architects) built especially for its use.

*Dedicated in June, 1916, but completed in 1917, was Walker Memorial, designed as a recreational center for students, and so used even today.*

Numerous though all these buildings seemed at the time, in less than 10 years, they, too, were inadequate to accommodate annual increases in enrollment, and the Institute solved the dilemma with characteristic originality and enterprise; it moved. Classrooms, laboratories, shops, libraries, and lecture halls were all moved from Boston to Cambridge. After possible sites in Boston were rejected, 50 acres on the Charles River Embankment were chosen in 1911. M.I.T. bought the land, constructed one vast edifice to house its diverse activities, and on June 14, 1916, dedicated its new establishment with ceremony due such an ambitious undertaking.

The new site in Cambridge gave to M.I.T. a sweeping view of Boston. The Charles River in the foreground adds perspective and interest to the symmetrical design of M.I.T. buildings that is forceful in its simplicity and imposing in its classic proportions. The architect, William Welles Bosworth, who was graduated from M.I.T. in 1889, brought to his task experience in complex building projects and a brilliant ability to create powerful compositions by sketching in all details with broad, sweeping strokes.

For M.I.T., Bosworth imagined a design in the grand classic tradition that harmonizes perfectly with the setting overlooking the Charles. The buildings flow from either side of a monumental portico in broad straight lines that parallel the River and its bordering highway. The center is marked by a great dome that dominates the composition and emphasizes the symmetry of the classic order. On the ground floor under the great dome may be found the dynamos and motors of the Department of Electrical Engineering.



*Dormitory buildings built between 1924 and 1931 were intended to form a quadrangle. The east and west sides of the quadrangle have not been built to connect the east wing* (left) *with the west wing* (right).

The central buildings of the group form a major court with two smaller lateral courts that appear as flanking pavilions, although there is no interior division between the individual buildings. Unity of design was achieved by reducing the Ionic order of the central building to a minor scale of two thirds in the lateral courts.

The immense dome of the central building is patterned after the Pantheon in Rome. Actually it consists of two drums of reinforced concrete – one set within the other, with a spherical cap over the second. The portico of the main façade, distinguished by 10 Ionic columns, borrows depth from the width of the central court, for actually it is shallow in order not to darken the interior lobby.

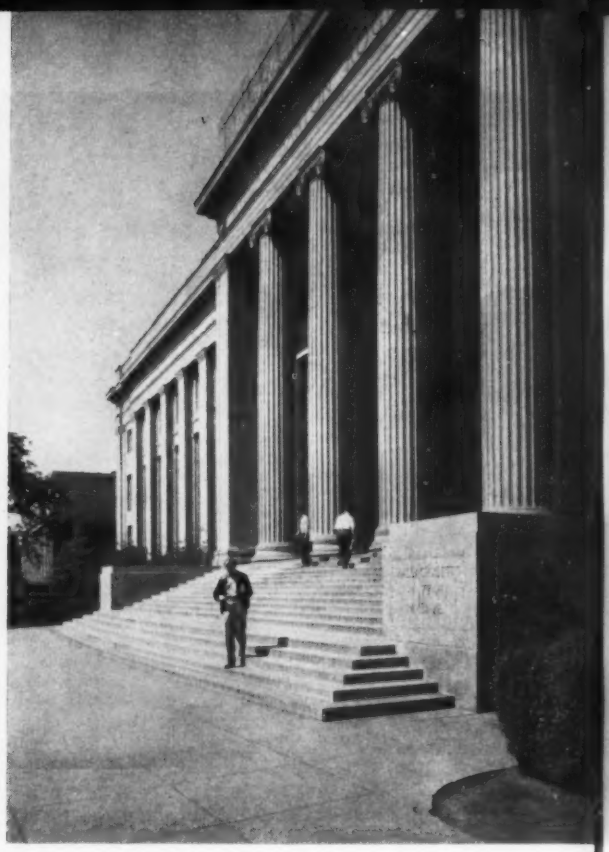
In the orientation of the buildings as a group, care was taken to arrange them so that classrooms would secure a maximum amount of sunlight. This first group of buildings, like many of later date, was of limestone with a warm tone that reduces glare from the sun. Landscaping the grounds had to wait until 1928 when the courts were graded and planted with turf, elms were set in orderly rows parallel with the buildings, and sycamore, dogwood, and other trees and shrubs were massed in low-growing groups before the main portico. Finally, connecting paths were laid out between the various entrances.

The new buildings were designed to accommodate all the educational activities which ranged through the fields of engineering, science, and naval architecture, with the exception of architecture which remained in the Rogers Building in Boston until a later date. The circular room under the dome, originally intended as an auditorium, with appropriate monumental staircase, was used as a library with a narrow, inconspicuous flight of stairs. Lecture halls, classrooms, drafting rooms, laboratories, shops, and several specialized libraries were arranged throughout the new buildings in a logical plan according to use and type of equipment. The first group of buildings was finished in 1916 and was planned for 2,000 students. But M.I.T. wisely adopted a policy of providing for expansion adequate for twice that number by additions to this central core that would preserve the unity of its architectural design.

Another building, east of the educational group, was also dedicated in June, 1916, although it was not completed until 1917. This was Walker Memorial designed by Bosworth to serve as a recreational and social center for students who had lacked a common dining hall and meeting place for college activities during the early years of the Institute in Boston. Bosworth adopted the same style and gray limestone for

*This photograph shows the George Eastman Research Laboratories of Physics and Chemistry as they appeared shortly after the Eastman structure was completed in 1932.*

*Entrance to the Pratt School of Naval Architecture and Marine Engineering, built in 1920. Large ship's anchors now adorn the entrance on each side of the staircase.*



*The new William Barton Rogers Building, built in 1938, serves as main entrance to the Institute and houses the School of Architecture and Planning in Cambridge.*

Walker Memorial as was used for the main educational group so that all buildings, which soon included dormitories, would have a homogeneous appearance.

Walker Memorial faces the Charles River and is a solid building that conceals, behind its classic façade, the various activities it was intended to accommodate. The portico is not wide but its six massive Doric columns express the same dignity and strength as is expressed in the other Bosworth buildings. The first floor was devoted to a dining hall, while other sections of the building were reserved for athletic or social purposes, with one room set aside for meetings of the Corporation of M.I.T. The walls of the main hall are decorated with murals designed by Edwin Howland Blashfield and painted by his assistant, Vincent Aderente. Blashfield, who was graduated from M.I.T. in 1869, had a long and distinguished career in mural painting; included in his accomplishments were the murals for the interior of the dome in the Library of Congress. In 1923, although nearly 80 years old, Blashfield undertook to design and to direct the entire Walker Memorial project, partly as a commission and partly as a gift. Aderente completed the central panel with such success that Blashfield was encouraged to add two panels on the opposite wall and to repaint the entire hall in order to unify and to harmonize the room as a whole.

*The official residence of the Institute's president is this handsome structure completed in 1917, and first occupied by Richard C. Maclaurin.*

During its years in Boston, M.I.T. had no dormitories, although a group of individuals constituting the Technology Chambers Trust put up one hall on Huntington Avenue in 1902 that was supervised unofficially by the Institute. This was designed by Walter H. Kilham, '89, for 178 students, but Technology Chambers housed a very small proportion of undergraduates.

When M.I.T. moved to Cambridge, Bosworth was commissioned to draw plans for a dormitory unit of six houses, named Ware, Atkinson, Runkle, Holman, Nichols, and Craft. Built on Memorial Drive in 1916 this dormitory was designed in the classic tradition

*(Continued on page 322)*

# Tornado in New England

## *Stricken Region of Central Massachusetts Rebuilt through Huge Co-operative Effort of Rehabilitation*

By WALTER C. VOSS

*A certain man went down from Jerusalem to Jericho, and fell among thieves, who stripped him of his raiment, and wounded him, and departed, leaving him half dead. . . .*

*But a certain Samaritan . . . came upon where he was, and when he saw him, he had compassion on him. And went to him, and bound up his wounds . . . and set him on his own beast, and brought him to an inn, and took care of him. And on the morrow when he departed, he took out two pence, and gave them to the host, and said unto him, Take care of him; and whatsoever thou spendest more, when I come again, I will repay thee.* — Luke 10:30, 33-35.

JUNE 9, 1953, provided the incident and setting for the most realistic application of the typical American reaction to a great need. In the early afternoon of this hot and humid day, the inhabitants of a 40-mile belt of countryside in central Massachusetts, including the 11 communities of Petersham, Barre, Rutland, Holden, Worcester, Shrewsbury, Westboro, Southboro, Northbridge, Sutton, and Wrentham, were apprehensive of the ominous darkness of the sky and the dead stillness which usually precede a thunderstorm. As usual they closed their windows or hurried a bit on their way home and waited for the thunder, lightning, and rain. But this afternoon was to be different. Warm, moist air had been moving in from the Gulf of Mexico and a layer of cold air from the northern Pacific regions was moving in over the warm air. A strong ground wind current caused the warm air to rise up into the upper, colder air. Then the air pressure dropped suddenly from a normal of 15 pounds per square inch to 11 pounds per square inch. This provided the differential necessary for high winds which coiled into the cone of the most disastrous tornado ever experienced in the history of New England.

At about 4:30 P.M. the first fury of this upheaval of nature vented its force on a Petersham meadow, blasting a crater about 100 feet in diameter and 6 feet deep. It moved on from here at a speed of about 40 miles an hour, accompanied by heavy rains, hail, and thunder and lightning. It did not lose its fury until it reached the town of Wrentham, where it subsided at 5:40 P.M. Passing through and striking less densely populated areas, it nevertheless, in a little more than an hour, left in its path, 88 dead, over 1,000 injured, demolished 641 homes, seriously damaged 2,028 others, ripped through the 600-unit federally aided Great Brook Valley Gardens and the 390-unit state-aided Curtis Apartments projects, and left 12,000 persons homeless. Property damage was estimated at $60,000,000. Then the sun came out and the sky cleared as if nature was taking compassion on the area by providing it with a period of daylight and respite to bind up its wounds.

An analysis of the forces involved in the action of a tornado of these proportions discloses some fantastic figures. The vortex of this tornado varied in breadth from 300 feet to 2,500 feet in its oscillations. The circumferential velocities of the wind in the rising swirl varied from 350 to 500 miles per hour. Using the commonly accepted empirical relation between velocity and pressure, these velocities would indicate average static pressures varying from 490 to 1,000 pounds per square foot. When these are translated into impact

*The tornado that crossed central Massachusetts on June 9, 1953, completely demolished wooden frame buildings* (left) *but concrete framed buildings* (right) *remained standing, even though damage to the interior was appreciable, and roofs were ripped off.*

*Marvin Richmond*

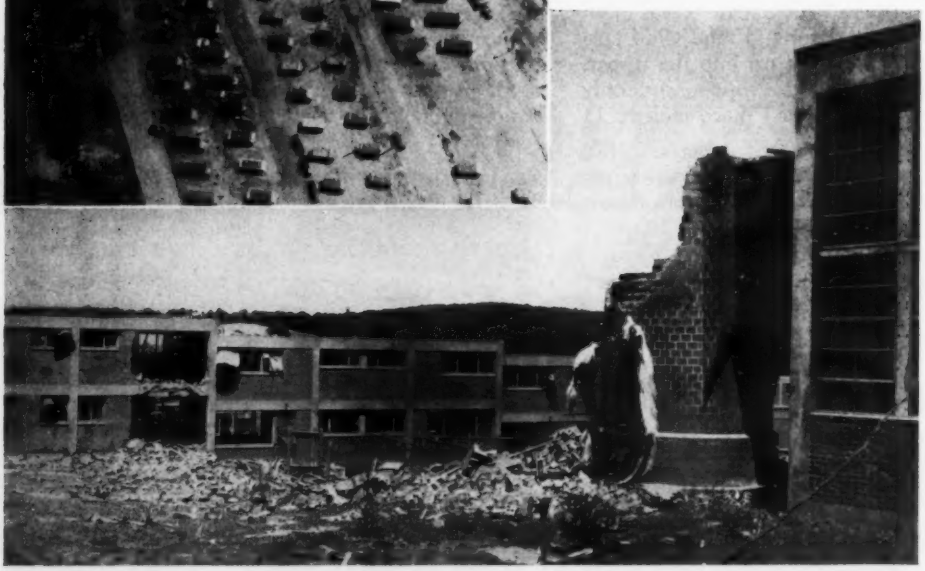
effect, they may rise as high as 2,000 pounds per square foot. If one adds to these forces the boundary effects of partial vacuums produced by restrictions in the path of the moving air, it becomes increasingly clear that local areas could exist where the effects far surpass the pressure effects of the original atomic bomb. When one remembers that our structures are designed to resist safely lateral forces of only 40 pounds per square foot, it becomes even more evident how hopeless the situation was.

As a result, wooden framed buildings were demolished. Buildings which were built with bearing walls for the support of concrete slabs or steel interior frames were destroyed in part, when pressures and vacuums coupled to lift slabs long enough to allow pressure pulses to blow out bearing walls before the slabs could return to their original position upon release of the pressures. This was clearly demonstrated in the state-aided Curtis Apartments project. The completely concrete-framed federally aided Great Brook Valley Garden Apartments project was left in a structurally sound condition except for the collapse of the two high stacks of the powerhouses and the damage done by the impact of debris hurled against the walls. In both of these projects the roofs were stripped off of all buildings, glass sheared off close to the metal frames, and contents of all apartments were badly damaged in almost all cases.

With the prompt realization of the extent of the catastrophe, local, state, and federal officials moved swiftly to cope with the situation. Francis J. McGrath, City Manager of Worcester, immediately declared a state of emergency. Civilian Defense, which had made plans for disaster relief, was quickly mobilized. National Guard units were ordered on to the scene before dark. More than 100 State Police were moved in. The entire area was placed under complete guard. Police, fire department, and public works personnel worked around the clock. Trucks, axes, flashlights, stretchers, and other necessities were moved in by Civil Defense together with their personnel. The Red Cross and the Salvation Army, assisted by thousands of volunteers, moved in to aid the injured, the homeless, and the confused victims of the tragedy. Canteens were set up to furnish food and drink not only for the unfortunate but for the personnel who worked without thought of rest or self. The injured were rushed to hospitals. The shelter of the Armory, Worcester Polytechnic Institute, Holy Cross College, and other institutions, as well as the homes of hundreds of private families, were offered for the temporary housing and comfort of the refugees. Worcester Municipal Auditorium was made headquarters for disaster relief, where clothing, supplies, furniture, and other immediate needs soon piled up. The heartwarming experience of viewing the sacrifice and selflessness of the ordinary person was stimulating and made one sense the tremendous reservoir of sympathy and service which is inherent in the American people. Nothing was too hard or too much. Blood banks were set up and were soon crowded with donors. Weary hours of searching through ruins, providing necessities and caring for others were commonplace duties.

(*Continued on page 318*)

*Worcester* Telegram-Gazette



*Trailers from all parts of the country were set up in empty lots or on the site of damaged homes to house those whose homes were damaged* (above). *Large brick smokestacks were toppled in the tornado, but concrete and brick structures remained structurally sound. Interiors were badly damaged by wind and debris, and roofs were torn off, but damage was not as great as to wooden dwellings.*

*Marvin Richmond*

# THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

## *Administrative Appointments*

THE appointments of Admiral Edward L. Cochrane, '20, as Vice-president for Industrial and Governmental Relations, and of Professor C. Richard Soderberg, '20, as Dean of the School of Engineering at M.I.T., were announced on March 4 by James R. Killian, Jr. '26, President of the Institute. The appointments became effective on April 1.

In the new post of Vice-president for Industrial and Governmental Relations, Admiral Cochrane, who has been Dean of Engineering since 1952, will be concerned with the whole range of the Institute's responsibilities to industry and government. He will serve to co-ordinate and to give administrative support to the special research and advisory activities at the Institute undertaken for industry and government, both national and local, and he will assist the president in discharging the executive responsibilities for this program. He will be a member of the Institute's Corporation.

Dr. Soderberg, who succeeds Vice-president Cochrane as Dean of Engineering, is widely known in the field of applied mechanics and is internationally recognized as an authority on turbine design. Before coming to the Institute in 1938, Dr. Soderberg was manager of the turbine division of the Westinghouse Electric Corporation. He has been head of the Department of Mechanical Engineering at M.I.T. since 1947.

In announcing the two appointments, President Killian said:

The Institute's growth and its enlarged responsibilities for public service require a further division and re-definition of administrative responsibility. Creation of this new vice-presidency will permit Julius A. Stratton, '23, who is Vice-president and Provost, to devote his primary attention to the Institute's educational program and will greatly assist me in handling the administrative aspects of the Institute's relations with industry and government.

Admiral Cochrane is recognized as a distinguished engineer and administrator in both maritime and educational fields. He has made outstanding contributions to defense, to the public service and to education.

*M.I.T. Photo*

**Edward L. Cochrane, '20**

*Vice-president for Industrial and Governmental Relations*

*M.I.T. Photo*

**C. Richard Soderberg, '20**

*Dean of the School of Engineering*

The Institute is also most fortunate in having available so distinguished a teacher and engineer as Professor Soderberg to be Dean of the School of Engineering, the largest of the Institute's five schools.

Vice-president Cochrane will have administrative responsibility for the Division of Industrial Coöperation, the Division of Defense Laboratories, and for the Industrial Liaison Office. He will be chairman of an administrative co-ordinating committee for the Lincoln Laboratory, the members of which will include: Professor Albert G. Hill, Director of this Laboratory; the Vice-president and Provost; the Director of the Division of Defense Laboratories; and the President.

After studying at the University of Pennsylvania from 1909 to 1910, Admiral Cochrane entered the United States Naval Academy and was graduated with distinction in 1914. He did graduate work in naval construction at the Naval Academy and also at M.I.T., where he received the degree of master of science in 1920. During World War I, and from 1920 to 1924, he was assigned to the Philadelphia Navy Yard. From 1924 to 1929 he was assigned to the Bureau of Ship Construction and Repair.

He was named chief of the Bureau of Ships, with the rank of rear admiral, in 1942, became a vice-admiral in 1945, and the following year was appointed chief of the Navy Materiel Division of the Office of Assistant Secretary.

In 1947 Admiral Cochrane retired from active duty in the Navy to assume the duties of head of the Department of Naval Architecture and Marine Engineering at M.I.T. In the same year he was named to the President's Advisory Committee on Merchant Marine. In 1950 he was appointed by the President to be chairman of the Federal Maritime Board and Maritime Administrator in the Department of Commerce. He served in this dual capacity until October, 1952, when he became M.I.T. Dean of Engineering.

Dr. Soderberg, the new Dean of Engineering at M.I.T., was born in Ulvohamn, Sweden, in 1895. He has had wide experience, both in this country and abroad, in the general mechanical and electrical problems of large power machinery.

After studying at the Technical Gymnasium in Harnosand, Sweden, Dr. Soderberg entered Chalmers Institute of Technology in Göteborg, from which he was graduated as a naval architect in 1919. He spent a year in advanced study in naval architecture at M.I.T., where he received an S.B. degree.

After a year on the technical staff of the New York Shipbuilding Corporation, he joined the heavy traction railway department of the Westinghouse Electric Corporation and in 1924 was transferred to the power engineering department, where he specialized in problems of large turbine generators. In 1928 Dr. Soderberg returned to Sweden for two years to undertake development of large turbine generators for the Swedish General Electric Company. He returned to Westinghouse in 1930, was appointed in 1938 to the Institute staff as professor of applied mechanics, became professor of mechanical engineering in 1942, and head of the Department in 1947.

## *Faculty Changes*

THREE appointments to the Faculty of the Institute have been announced. After serving as president of Antioch College for five years, Douglas M. McGregor returns to the Institute next July to accept the post of professor in the School of Industrial Management. Leo R. Sario has been named visiting associate professor in the Department of Mathematics, and William J. McGill was appointed assistant professor of psychology in the Department of Economics and Social Science.

Dr. McGregor was a member of the M.I.T. Faculty from 1937–1948. He is a graduate of Wayne College and Harvard University; and, during his years with M.I.T.'s Department of Economics and Social Science was promoted from instructor to full professor of psychology and director of the Industrial Relations Section.

Dr. Sario is a native of Finland and received the degree of doctor of philosophy at Helsinki University, where he was a teacher before coming to the United States in 1950. The following two years he served at the Institute for Advanced Study in Princeton, and from 1952–1953 was a research fellow at Harvard University. Dr. Sario has published extensively in the field of Riemann surfaces.

Dr. McGill, formerly a staff member of M.I.T.'s Division of Industrial Coöperation and a part-time instructor in psychology, received the degrees of bachelor of arts and master of arts at Fordham College. In 1953 he was awarded the degree of doctor of philosophy by Harvard University. Dr. McGill served as an instructor at Fordham College from 1947–1948 and at Boston College from 1948–1949, and was a teaching fellow at Harvard University from 1949–1950.

Recent resignations include: Lawrence B. Arguimbau, Associate Professor of Electrical Communications; Reinhardt Schuhmann, Jr., '38, Associate Professor of Metallurgy; and Charles W. Steinmetz, instructor in the Department of Modern Languages.

## *Bibliodynamics*

BIBLIODYNAMICS — The Charles Hayden Memorial Library," a 16-millimeter color sound motion picture just completed by the Library, received its first preview showing before James R. Killian, Jr., '26, President of the Institute, and Karl T. Compton, chairman of the M.I.T. Corporation, and others on January 19, 1954.

Narrated by Paul M. Chalmers, Associate Director of Admissions, the script was prepared by Miss Margaret P. Hazen and other members of the Library staff, assisted by Walter L. Milne of the Institute's News Service. Photography and sound recording were by Oscar H. Horovitz, '22, an amateur cinematographer of international reputation, who also directed the film with the assistance of Robert E. Booth, Associate Librarian. Musical score was taken from a tape recording played at the Library dedication.

This is one of the first color sound films recorded on a magnetic sound strip that has subsequently been converted into an optical color sound print.

### *Class Reunions*

In the main, classes to hold reunions this year will be those whose numerals end in four or nine. Presented below is the information available to date on the locations and dates for these gatherings.

1894 Reunion on campus at M.I.T. Samuel C. Prescott, Secretary, Room 16–317, M.I.T., Cambridge.

1899 June 11–13. Burton House, M.I.T., Cambridge. Burt R. Rickards, reunion chairman, 381 State Street, Albany 10, N.Y.

1900 June 15–17. The Pines, Cotuit, Mass. Elbert G. Allen, Secretary, 11 Richfield Road, West Newton 65, Mass.

1904 June 11–13. 50th reunion at Oyster Harbors Club, Osterville, Mass. Carle R. Hayward, reunion chairman, Room 35–304, M.I.T., Cambridge.

1909 June 11–13. Chatham Bars Inn, Chatham, Mass. Francis M. Loud, reunion chairman, 351 Commercial Street, Weymouth 88, Mass.

1912 June 11–13. Snow Inn, Harwich Port, Mass. Frederick J. Shepard, Jr., Secretary, 31 Chestnut Street, Boston, Mass.

1914 June 19–21. Sheldon House, Pine Orchard, Conn. Charles P. Fiske, reunion chairman, 1775 Broadway, New York 19, N.Y.

1916 June 11–13. The Treadway Inn (formerly Coonamessett), North Falmouth, Mass. Ralph A. Fletcher, Secretary, Box 71, West Chelmsford, Mass.

1919 June 11–13. Wentworth by the Sea, Portsmouth, N.H. Wilfred O. Langille, reunion chairman, Diehl Manufacturing Company, Finderne, Somerville, N.J.

1924 June 11–13. Sheldon House, Pine Orchard, Conn. George W. Knight, reunion chairman, 36 Arden Road, Watertown, Mass.

1929 June 11–13. 25th reunion at Baker House, M.I.T., Cambridge, Walter H. Gale, reunion chairman, Room 3–207, M.I.T., Cambridge.

1934 June 11–13. Wentworth by the Sea, Portsmouth, N.H. Carl H. Wilson, reunion chairman, 79 Damon Avenue, Melrose 76, Mass.

1939 June 11–13. Snow Inn, Harwich Port, Mass. Oswald Stewart, 2d, reunion chairman, 36 Pleasant Street, Marblehead, Mass.

1944–2 June 11–13. Hotel Curtis, Lenox, Mass. Henry
1944–10 C. Bourne, Jr., reunion chairman for 1944–2, Room 10–119, M.I.T., Cambridge. F. Scott Carpenter, Jr., reunion chairman for 1944–10, 39 Middle Street, Hingham, Mass.

1949 June 12–13. Chatham Crest, Chatham, Mass. Archie H. Harris, 3d, reunion chairman, Arthur D. Little, Inc., 30 Memorial Drive, Cambridge.

Please contact your class secretary or reunion chairman for the latest plans on your class reunion. Advance notice of attendance will assist in planning Alumni Day (June 14) and class reunion events.

## *Sophomore Composer*

THE first performance anywhere of an original march by Andrew F. Kazdin, M.I.T. sophomore from Larchmont, N.Y., was the concluding work in a performance by the M.I.T. Concert Band at Tufts College on Friday, March 12. In addition to Kazdin's composition, *Marche Baroque,* the program included the *Military Symphony in F* by Gossec, the *First Suite in E Flat* by Holst, and other works by Milhaud, Piston, and Perschetti.

The 50-piece M.I.T. Concert Band was under the direction of John Corley. Its performance, sponsored by the Tufts College Department of Music, was held in the Henry Clay Jackson Gymnasium on the Tufts campus in Medford, and was open to the public with no admission charge. Members of the M.I.T. Band were entertained at a dance following the concert.

## *Chairman, Freshman Advisory Council*

NORMAN C. DAHL, '52, Assistant Professor of Mechanical Engineering at M.I.T., has been named to the chairmanship of the Institute's Freshman Advisory Council, it was announced in March.

Professor Dahl assumed his new duties on March 6 at an all-day meeting of the Council. He succeeds Professor Francis Bitter of the Physics Department, who had been head of the advisory group since it was established in 1952 to further close student-faculty relationships and to help students develop in professional competence.

## *R. H. Robnett: 1905-1954*

RONALD H. ROBNETT, Associate Dean of the School of Industrial Management since 1952, passed on at his home in Winchester on February 16. A native of Salem, Ore., where he was born in 1905, Dean Robnett was educated at the University of Oregon, from which he was graduated with the degree of bachelor of science in 1928. He remained at the University of Oregon for four years as assistant graduate manager. He took up graduate work at Harvard University, receiving the degree of master of business administration in 1934, the year in which he joined the staff of the Institute as an assistant in the Department of Business and Engineering Administration. He became assistant professor in 1937, associate professor in 1942, and professor of accounting in 1947. Before becoming associate dean he had served as fiscal officer of the Division of Industrial Coöperation at M.I.T.

Dean Robnett was a member of the Institute's Committee on Educational Survey from 1947–1950 and in 1947 was a member of the Advisory Board on Relationships of the Atomic Energy Commission with its contractors. In 1948 he served on the Advisory Committee Research and Development Contracts of the Department of the Army and in the following year was consultant to the chairman of the Research and Development Board of the Department of Defense.

A member of the National Association of Cost Accountants, Boston Chapter, Dean Robnett had been a director of that organization since 1937.

## *Council Comments*

As President of the Alumni Association, Horatio L. Bond, '23, opened the 301st meeting of the Alumni Council at the M.I.T. Faculty Club on March 1, at which 103 guests and members were present. As Secretary, Donald P. Severance, '38, reported on the success of the Midwinter Meeting (as reported on page 253 of the March, 1954, issue of The Review); enumerated two changes in class affiliations; reported that between January 19 and February 9, an even dozen M.I.T. Clubs as remote as Havana, Knoxville, St. Louis, and Schenectady, had been visited by 19 members of the Technology Faculty and staff.

Also recorded was the action of the Executive Committee in voting a change in alumni dues and subscription rates to The Technology Review.

The Executive Committee voted to recommend to the Council that Article VII, Section 1, of the Bylaws be amended by substituting "four dollars ($4.00)" in place of "three dollars ($3.00)" in the first sentence, and "$4.00 or more" in place of "$3.00 or more" in the second sentence, so that Article VII, Section 1, as amended shall read:

> The annual dues, including subscription to *The Technology Review*, shall be four dollars ($4.00) for all types of members of the Association, other than Honorary or Life Members.
>
> Any member who in any year has made a contribution to the Alumni Fund of $4.00 or more shall thereby have paid his dues to the Alumni Association for that year.

It was further recommended that action be taken at the April 26 meeting of the Council according to Article X of the Bylaws. This article provides that the Bylaws may be amended at any time by a majority vote of the full membership of the Council, provided thirty days' notice has been given through publication in *The Review* or by mail to the full membership of the Council.

Also reported was action of the Executive Committee on May 26, 1952, in appointing Leicester F. Hamilton, '14, Harl P. Aldrich, Jr., '47, and Hugh S. Ferguson, '23, chairman, to serve on a committee to study the status of graduate students at M.I.T., whose undergraduate training was received elsewhere. This committee was charged with the responsibility of recommending ways of providing more effective participation in matters relating to M.I.T. and the Alumni Association. The committee's recommendation was accepted with appreciation by the Council, but is of sufficient importance that it will be reported in substantial detail in a forthcoming issue of The Review.

Raymond H. Blanchard, '17, chairman of the National Nominating Committee, presented the slate of nominees listed in the March, 1954, issue of The Review, and Henry B. Kane, '24, as Alumni Fund Director, reported that, as of March 1, a total of 7,915 Alumni had contributed $181,945 to the Alumni Fund for the current year.

President Bond next introduced the nominees for office in the Alumni Association who were present, members of the M.I.T. Corporation, past presidents of the Association, and others at the head table. He then asked James R. Killian, Jr., '26, President of the Institute, to address the Council.

Dr. Killian spoke briefly on the day's Corporation meeting and the several Departmental Visiting Committees falling in the period of February 27 to March 4. In this connection he cited the profound part that some of the Visiting Committees have played, a success probably unmatched at any other college. The Council can be proud of that record, for two members of each Visiting Committee are nominated by the Association, and some or all Corporation members of the Committees may also include Alumni.

Dr. Killian next spoke of the undergraduate admissions outlook for next fall. Applications for admission are 32 per cent ahead of a year ago, and it is estimated that there will be 2,400 final applications from which the freshman class of 900 will be chosen. As most college applicants submit their credentials to several colleges, the Institute can expect a considerable attrition from the group initially admitted. Another significant trend is that the Institute has received twice as many applications for scholarships as two years ago.

Professor Arnold Tustin, the first Visiting Webster Professor of Electrical Engineering, compared the effect of the invention of the electron tube on the electrical engineering industry to the effect of the new hormone weed killers on weed and plant. In the latter case, the weeds grow better, but this starves the root which withers, and the plant dies. Since the advent of the electron tube, industry has sprouted radio, television, radar, guided missiles, automatic control, and so forth. It is Tustin's concern that this has diverted to these new fields much of the vitality of the longer-established branches of the electrical industry.

It is his observation that throughout universities in Europe and in the United States today one finds everywhere teachers and students active and enthralled in every variety of study and development in electronics; but almost no new work, almost no research and, most significant of all, very little enthusiasm in the fields of electrical power supply, power utilization and application and machine development is to be seen. The question therefore arises of whether some steps ought now to be taken to insure no falling off of progress, and the prompt exploitations of new technical possibilities in these fields.

Antoine M. Gaudin, Richards Professor of Mineral Engineering, presented a four-point program for assuring this country a supply of metals and minerals adequate to satisfy its increasing industrial appetite. The first need is for finding more mineral deposits. Dr. Gaudin recommended appreciable expenditures for geophysical prospecting on a long-range, national scale. It is not in the least uncommon to have 10 or 15 years elapse between the discovery of a major ore body and the first full-scale utilization of it.

The making of ore out of what is now waste, or what might become waste, by improving the methods of processing was Professor Gaudin's second point. Wasting less of the material may eventually prove to be an important part of any mineral and metal policy for this country.

The increasing of imports of minerals and metals by protecting American capital and know-how in foreign lands was Professor Gaudin's fourth point. It seems apparent that we shall always depend somewhat on foreign sources for certain of our minerals.

# BUSINESS IN MOTION

## *To our Colleagues in American Business . . .*

Recently a manufacturer who planned to make a new electric coffee percolator came to Revere with a variety of problems. The first concerned the selection of a metal which would assure a quality product, yet be capable of economical fabrication in his plant. A Revere Technical Advisor consulted with the company's design engineers, and recommended copper in a temper suitable for deep drawing. The suggestion was based on the fact that this metal is ideally suited because of its excellent forming characteristics, the fine finish obtainable, and the ease with which it can be plated.

In order to give further assistance in the development of the new product, a thorough study was made of the customer's production equipment. It was pointed out that there were several possible methods of making the percolator body. Mutual analyses pointed out the best of these. This activity was especially appreciated, because the manufacturer had previously done little with copper, having worked chiefly with aluminum. Both metals, of course, can be put through the same equipment, but since they have different characteristics, switching from one to the other requires special consideration of such matters as tooling, annealing, and finishing.

During the period of trial runs and initial production Revere continued to work closely with the customer. Today the percolator is used daily in the homes of a growing number of satisfied owners. The fact that the manufacture of this new product started so smoothly and quickly was due in large part to the desire of the customer to collaborate completely with the Technical Advisory Service, and take full advantage of our experience and knowledge.

First Revere contact was with the Purchasing Department. That is standard procedure. Subsequently it was made possible for us to work with the design and tool engineers, methods engineers and production supervisors, in fact with practically everybody who had a position of responsibility in regard to the new product.

Some Revere customers ask only for Revere Metals; others, as in this case, seek our engineering and production know-how, obtained over many years in the field. Our special technical services, please understand, are not billed; they are a part of our contribution to the welfare of American industry, with which our own welfare is so inter-woven. Naturally, such services are provided on a confidential basis, and trade and production secrets are respected.

Suppliers to every industry are just as eager as is Revere to win fast friends and loyal customers. Therefore it is suggested that no matter what materials you buy, nor what you produce from them, you take your suppliers into your full confidence. Adding their knowledge and skill to yours should pay you well, at no extra cost.

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## ATMOSPHERIC POLLUTION

(*Continued from page 296*)

Connecticut Valley and the expenses shared by these towns and cities and by the Commonwealth.

The citizens of Holyoke who live along the river petitioned their own Board of Health to alleviate the smoke nuisance caused by various plants located in their city. Controlling the nuisance at its source would not only benefit the people living in Holyoke but also those in Chicopee. The survey pointed out to the Holyoke Board of Health those plants that were the chief offenders, with photographs and laboratory data presented as proof. Through co-operation of the Board of Health, the mayor, and the press, proper and sufficient pressure was brought to bear on these plants. To date, some of these plants have spent considerable amounts of money in correcting the condition causing the nuisance and have installed the latest fly ash arresting equipment.

Occasionally, a temporary change in a plant process or in power-house equipment may result in conditions which will cause or aggravate a nuisance hazard and result in subsequent complaints by the public. Recently, at the request of the Board of Health of Maynard, we investigated complaints by people living in Maynard that fly ash or cinders were being deposited in great quantities on their properties. A local woolen mill, which was the only plant in the town, was found to be the source of this atmospheric pollution. The homes of the complainants lay in the path of the prevailing wind. Laboratory tests substantiated the fact that the material came from the stacks of the woolen mill's power plant. The plant officials advised that during the past winter the company had started converting three of their five furnaces, so that oil could be used as a fuel. In order to maintain the required heat output during the conversion period, it was necessary to overload two of these coal-fired furnaces most of the time. The power plant engineer advised that this forcing of the furnaces resulted in an excessive amount of smoke, soot, and fly ash being discharged from the stacks. Formerly, the usual procedure was to use four coal-fired furnaces during the winter months; however, because of the changes made, only two coal-fired furnaces could be used. Conversion was completed a few weeks after our survey had been made. No further nuisance complaints were received by the local Board of Health.

Sometimes when the officials of industrial plants are made cognizant of the fact that their plants are guilty of atmospheric pollution, they plead that the cost of correcting or even alleviating the causative conditions and the time involved would be prohibitive and might force them to move their plant elsewhere. Are they justified in taking this stand in maintaining the *status quo*? Based on precedent alone, public health is considered of greater importance. The U.S. Supreme Court has issued the following opinion on smoke abatement:

So far as the Federal Constitution is concerned, we have no doubt that the state may, by itself or through authorized municipalities, declare the emission of dense smoke in cities or populous neighborhoods a nuisance and

(*Continued on page 312*)

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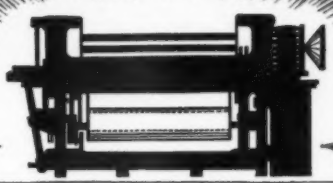

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## ATMOSPHERIC POLLUTION

(*Continued from page 310*)

subject to restraint as such; and that the harshness of such legislation or its effect upon business interests, short of a merely arbitrary enactment, are not valid constitutional objections. Nor is there any valid Federal Constitutional objection in the fact that the regulation may require the discontinuance of the use of property or subject the occupant to large expense in complying with the terms of the law or ordinance.

The development of water supplies, sewage disposal, and sanitation facilities has worked hardships on some to the ultimate benefit not only of the majority, but those who have been subjected to inconvenience and monetary loss. By making a thorough investigation of the causes of the atmospheric pollution, it may be found that instead of an expenditure of large amounts of money or time, that by a rearrangement or change in process, by improvement of firing and furnace tending, by the control of contaminants at their source, there would result a loss of less salvageable material and fuel, so that the necessary improvements would result in more efficient operation and lowered production costs.

Several cities, including St. Louis, Niagara Falls, and Pittsburgh, have set up elaborate smoke abatement programs, while other towns and cities have started surveys which may result in timely legislation for the elimination or reduction of atmospheric pollution. Not only is the smoke nuisance being investigated, but studies are being conducted in some cities, such as Cincinnati, to determine the concentration of metal fumes, fluorine, and sulfur dioxide in the city atmosphere, and the concentration of carbon monoxide in light, medium, and heavy traffic areas. Surveys seem to indicate that the greatest seasonal atmospheric pollution is found during the cold winter months and that the greatest daily contamination is usually found during the early morning.

A survey made to determine the degree of atmospheric pollution should be under the supervision of a qualified engineer. The engineer with his background should be cognizant of what equipment is necessary to determine the concentration of the atmospheric contaminants. Air sampling devices, as used in the determination of atmospheric pollution in working areas within the plant, may be adapted for measuring the amount of pollution in the air outside of the plant.

Smoke nuisance surveys should include soot-fall studies using deposit gauges. For the measurement of atmospheric pollution an apparatus called the Stand-

(*Continued on page 314*)


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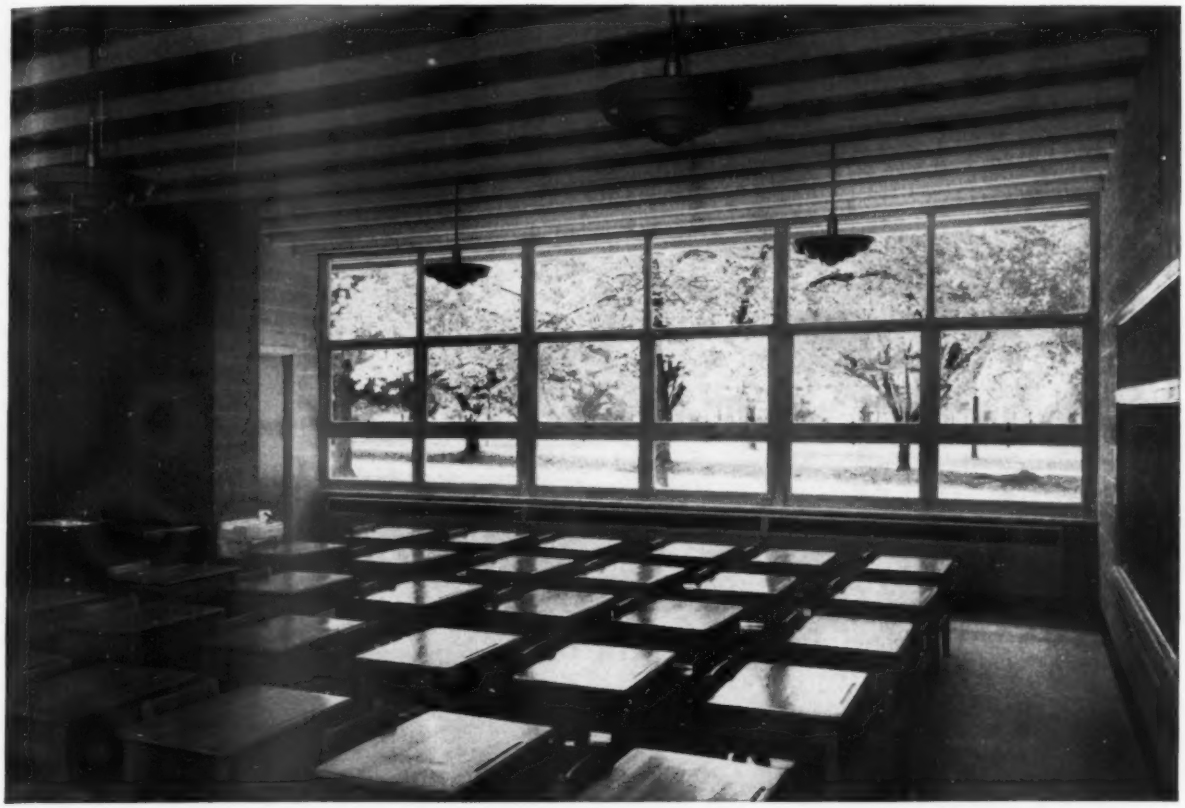

Classroom in Wakelon Public School, Zebulon, N. C. Architects: Page & Smith, Raleigh, N. C. Heating Contractor: Bullock & Proctor, Raleigh, N. C.

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## ATMOSPHERIC POLLUTION

*(Continued from page 312)*

ard Deposit Gauge is in general use in England. It consists of a glass basin 30 centimeters in diameter resting on an iron stand and raised about four feet above the ground. An aperture in the bottom of the basin is connected to one or more large bottles, placed underneath, which receive both the rain water and the deposit which falls into the gauge. Once a month the material collected in the bottle is separated by filtration into soluble and insoluble matter and may be further analyzed for carbonaceous constituents, ash, tar, ammonia, sulfates, and chlorides. The results may be expressed in tons per square mile. The deposit gauge as used in our country consists of a wide mouth jar about eight inches high. Approximately one inch of distilled water and glycerine is placed in the jar. A number of these jars are then placed on roof tops, open lots, hills, and other locations where they will be free from wind eddies. Stands should be provided to hold the jars at least three feet above the ground level. Samples are collected monthly. A pilot jar should be kept by the engineer as a low-water alarm.

One method of determining the intensity of smoke is by means of the Ringelmann Chart. This chart consists of black cross lines of a certain thickness and distance from each other forming varying white squares between them. The sizes are:

| *Number* | *Smoke* | *Lines* | *Thickness* | *Spaces* | *Width* |
|---|---|---|---|---|---|
| 0 | None | | | All White | |
| 1 | Light Gray | Black | 1 mm. | White | 9 mm. |
| 2 | Dark Gray | Black | 2.3 mm. | White | 7.7 mm. |
| 3 | Very Dark Gray | Black | 3.7 mm. | | 6.3 mm. |
| 4 | Black | Black | 5.5 mm. | White | 4.5 mm. |
| 5 | Very Black | All Black | | | |

The chart is hung on a level with the eyes, about 50 feet from the observer, as nearly as possible in line with the chimney. The engineer glances from smoke to chart and notes the corresponding number, recording the number and time of observation. Repeat observations are made at one quarter to one half minute intervals. From these records the average density may be determined for each hour or for each day. Experienced observers often record in half-chart numbers. The Metropolitan Boston Smoke

*(Concluded on page 316)*

William H. Coburn & Co.
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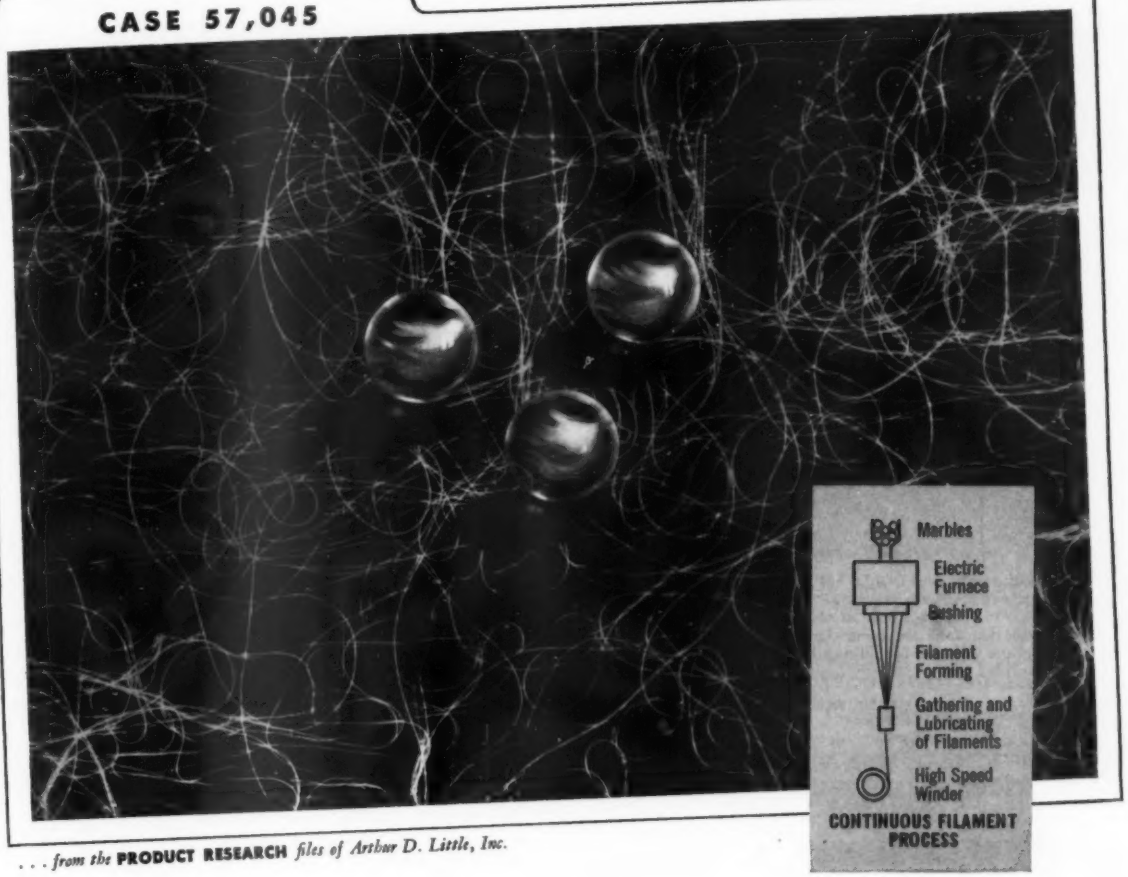


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## ATMOSPHERIC POLLUTION

(*Concluded from page 314*)

Abatement Commission allows Number 2 and Number 3 smokes for a period of three to six minutes in any one hour, depending on stack classification.

In presenting some aspects and incidents of atmospheric pollution by dust, fumes, and gases, an effort has been made to define some of the basic terms; to stress the importance of atmospheric pollution to the public, to government, and to plant management; to present some incidents and problems encountered while in contact with the public; and to describe some of the methods of survey and elimination of the cause for complaint. An endeavor has been made to present the problem in its true light so that further efforts will be expended by all concerned to investigate, study, and to help control or eliminate the factors causing pollution of the air we breathe.

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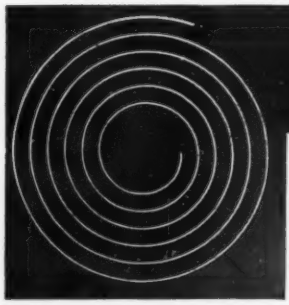

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## TORNADO IN NEW ENGLAND

*(Continued from page 304)*

In this story of man's humanity to man the efforts of the members of the Worcester Housing Authority and its able staff must be singled out for particular attention, not only for their prompt, organized, and incessant work immediately following the disaster but for their devotion to their duty to rehouse the temporarily homeless families and to move quickly, so that these unfortunate people might get back into their homes by repairing the damage before inclement weather. The personal risks taken by some of these people, far beyond the call of duty, are significant. David M. Hayes, Assistant Executive Director of the Authority, even though injured by the collapse of a section of a brick wall on his car (which embedded pieces of glass in his skull), and entirely oblivious to his own welfare, rushed into nearby buildings of the Curtis Apartments telling the occupants to get under cover and not to light matches. He found a live telephone and called police, fire and public utilities to prompt them into immediate action. Raymond P. Harold, '23, Chairman of the Authority, while on his way to Holden saw houses smashed and wires and trees down, went immediately to the scene but had to abandon his car because traffic had become hopelessly snarled. He too searched for a telephone, found none, then was able to flag down the first car that came along and proceeded to Great Brook Valley Gardens.

Colonel Joseph T. Benedict of the Air Force Reserve, and Executive Director of the Housing Authority, was waiting for a call from Mrs. Benedict to take him to North Worcester when a friend informed him of the terrible happenings in North Worcester. When his wife came, they immediately headed for the housing project area. The area was a shambles; people were wandering around dazed and injured. All about them were dead, dying, and injured — with the ambulances and police trying to master the situation. Benedict made his way to the administration office where he found Harold had already given instructions for setting up a first aid station. Harold immediately ordered the setting up of a trailer campsite on the site of the nearby Lincolnwood development which had been completely demolished. Then he and Laurence H. Fisher, Assistant Secretary of the Authority, at their own expense set out on a 4,000-mile, week-end airplane trip to expedite the shipment of trailers to

*(Continued on page 320)*


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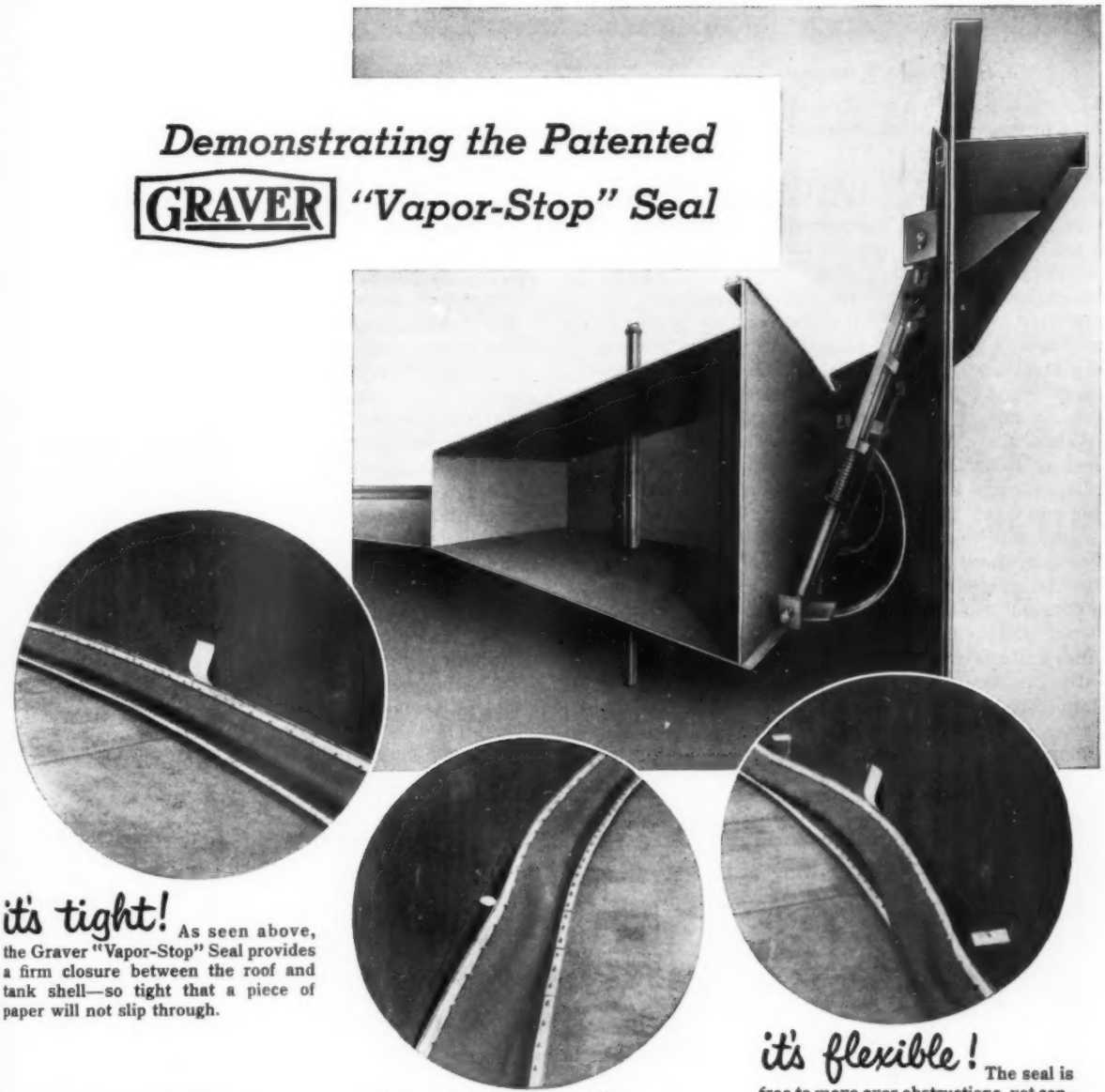
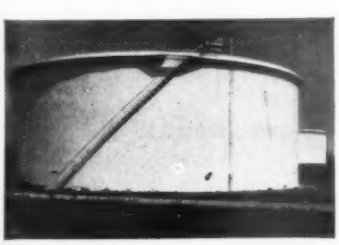


**it's tight!** As seen above, the Graver "Vapor-Stop" Seal provides a firm closure between the roof and tank shell—so tight that a piece of paper will not slip through.

**it's sensitive!** Despite its effective closure, the sealing mechanism is so sensitive it does not break the egg shown above, indicating the friction-free, long-lasting performance that the seal provides.

**it's flexible!** The seal is free to move over obstructions, yet continues to close the gap and prevent loss of vapors. It is successful on both converted tank shells and new construction.



The seal mechanism is an integral part of all Graver Floating Roof designs, including the Double-Deck Floating Roof tank and the Center-Weighted Pontoon and Pan-type Floating Roof tanks.

This patented seal is the key to the successful functioning of Graver Floating Roof tanks. Composed of two mechanisms—a weighted arcuate pusher and a spring-actuated hanger, it acts as a "Vapor-Stop," preventing loss of volatile vapors. The seal provides positive centering action for the roof. It also prevents the entrance of air and rain, and resists corrosion.

Simple and foolproof, it eliminates the need for multiple seals. The mechanisms are completely covered, and the fabric is asbestos coated with Neoprene, impervious to vapors. Graver's "Vapor-Stop" Seal is fire-resistant and Underwriters' Laboratories approved.

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## TORNADO IN NEW ENGLAND

*(Continued from page 318)*

Worcester, not being satisfied by the promise given them through the usual channels of communication.

They visited Wichita, Kan.; St. Louis, Mo.; Dallas, Tex.; Atlanta and Augusta, Ga.; and Aiken, S.C., where trailers were reported as available. Soon trailers were rolling toward Worcester, but not fast enough to satisfy Harold. He sent out a call for drivers who would go to Kansas and drive the trailers back to Boston. Dozens of drivers responded, deliveries were expedited, and soon 450 trailers were set, serviced, and families temporarily housed until repairs to their previous homes were completed. Some trailers were placed on the land of home owners whose houses were destroyed, so that they too might have shelter.

While all of these activities were going on, the Central Massachusetts Disaster Committee was established. George F. Booth, editor and publisher of the Worcester *Telegram* and the *Evening Gazette*, served as chairman, and Everett F. Merrill, former City Manager, and Bishop John J. Wright of the Worcester Diocese, as members. Through their efforts the relief of personal and financial loss was prompt and sympathetic. Stores gave clothing, food, and furniture. Cities and towns in Massachusetts gave the proceeds of their parking meters for long periods of time. The State, through the efforts of Governor Christian A. Herter, made additional funds available. The public responded generously with funds, clothing, food, temporary housing, and offers of assistance in conducting the work. By late fall of 1953 nearly $2,000,000 had been raised for relief. To this the Red Cross expended unknown sums for both material and financial relief. The insurance companies came to the immediate relief of those affected, setting aside usual procedures.

While the activities directly following the disaster have been generally known, very little is publicly known about the contributions made by many agencies and groups because of the continued concern of the Worcester Housing Authority to rehabilitate the badly marred housing projects which had just been completed under their charge before the tornado struck. Again it appeared that usual methods were too mercenary and self-seeking to provide what was necessary. Workmen deserted their usual employment and worked around the clock, in many instances without thought of remuneration. The contractors who had built the original projects were immediately called in and requested to move promptly toward repair and replacement of destroyed or impaired facilities. Although they had commitments on new projects elsewhere, they immediately brought in many of their men and much of their equipment from remote jobs for immediate action. In many cases they again worked around the clock under heavy pressure to meet, as soon as possible, the objective of the Housing Authority to get families into their houses.

The insurance companies, both stock and mutual, took immediate steps to provide funds for reconstruction. They set aside their usual procedure, in such cases, of first determining the amount of damage and

*(Concluded on page 322)*

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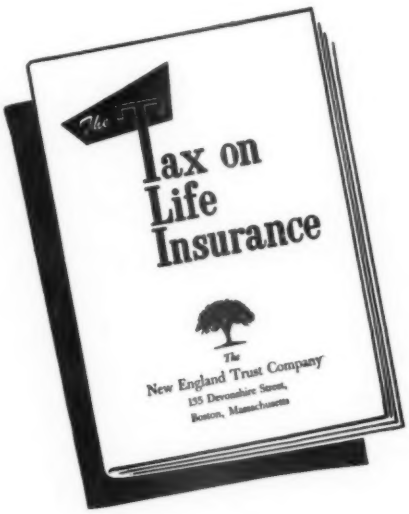


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## TORNADO IN NEW ENGLAND

(*Concluded from page 320*)

then negotiating for a complete settlement, realizing that the use of the time consumed by this procedure was incompatible with the speed required. Instead they made substantial sums available at once and added to these from time to time, to allow for the payment of the necessary costs of reconstruction, while negotiation on the extent of damage and their liability were going on continually, but not impeding progress. The willingness to compromise, the honest desire to do the fair thing, and the acceptance of the incidental sacrifices on the part of all were stimulating and wonderful to experience.

Rehabilitation is now nearly complete: families which had heavy financial burdens imposed upon them have had substantial relief, home life goes on as before, and a visit to the area today would show only minor scars of this terrible experience. Left is the appreciation of thousands of the efforts of modern society to meet catastrophe courageously, sympathetically, and with understanding and dispatch.

## ARCHITECTURE OF M.I.T.

(*Continued from page 302*)

with Pompeian accents, and the group as a whole exhibited the light and gay elements of a Roman villa. But it was planned, as were all living quarters, for practical student housing in accordance with the results of a study of dormitories at other colleges. Major contributions to this study were made by A. Farwell Bemis, '93, an eminent authority on housing problems and founder of the Bemis Foundation at M.I.T.

The dormitory group has six stories and a two-story loggia above the main building. From this loggia arches open into rooms described as "dens, attractive probably to students in architecture, small in comparison with the other rooms and for the moderate purse." The dormitory itself is L-shaped, a plan that allows sunlight to penetrate all sleeping rooms, for in designing this group sun and shadow were studied in relation to room arrangement.

In 1924, the second dormitory, designed by Bosworth as part of a quadrangle, was built north of Walker. While less elaborate than the first, Bemis dormitory is a plain rectangular building planned to form the central section of the east wing of a quadrangle. Its walls of cream-colored brick are broken by fluted pilasters and the doorways suggest classic dignity. As considerable study had been made of living require-


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ments for students, the rooms provide maximum comfort and privacy without luxury. Four years later, a unit was connected to either side of this dormitory – Goodale on the north and Walcott at the south – forming a continuous structure that completed the east wing. In 1931, the architects, Coolidge and Carlson (Harry J. Carlson, '92) constructed the entire west wing – Wood, Hayden, and Munroe – of the intended quadrangle which still lacks the enclosing north and south units. This wing is almost identical in appearance with the east group of dormitories, except for the central unit which has a parapet along the roof adorned with Grecian urns.

The president, no less than the students, was also provided for in M.I.T.'s new plan, and for him Bosworth designed a charming house that would be a graceful home for a gentleman of the Italian Renaissance. In 1917, the house was ready for Richard C. Maclaurin, Sixth President of the Institute, who presided at the dedication of the Cambridge buildings. The President's House is on Memorial Drive between Walker Memorial and the first group of dormitories. It is separated from Walker Memorial by Ames Street and is shielded from the dormitories by a row of tall cedars. Harmonizing in tone with the other buildings of the Institute, the President's House represents a subdued adaptation of Roman architecture to a dignified home. A garden for the President's House was designed by Mabel Keyes Babcock who received degrees from M.I.T. in 1908 and 1909. By a pattern of paved paths and the massing of dark evergreens, accented with lighter foliage of deciduous trees and shrubs, Miss Babcock carried the formal theme of the house throughout the planting of the grounds.

With the completion of the President's House in 1917, Bosworth's work at M.I.T. was not finished; he had yet to add two buildings to the educational unit: the Pratt School of Naval Architecture and Marine Engineering, and the William Barton Rogers Building for the School of Architecture and Planning. The first of these, built in 1920, extends northerly along Massachusetts Avenue from the southwest corner of the original group and is joined to it by corridors. In style and material it is uniform with the 1916 buildings, and its main entrance on Massachusetts Avenue is similar to the doorways of Walker, but over the entrance to the School of Naval Architecture a model of a Norwegian ship in limestone symbolizes the purpose of the School. Opposite the entrance is a small lobby which serves as a naval museum where models of

(*Continued on page 324*)

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## ARCHITECTURE OF M.I.T.

(*Continued from page 323*)

ships are on permanent exhibition, while the remainder of the building is devoted to classrooms, offices, and laboratories.

Twelve years passed before the School of Naval Architecture and Marine Engineering was balanced on the east side of Bosworth's group by a corresponding building known as the George Eastman Research Laboratories of Physics and Chemistry. These Laboratories were constructed in 1932 from funds donated largely by George Eastman, a generous benefactor of M.I.T. The architects, Coolidge and Carlson, united the new building to the original group as a long wing of the same height as Bosworth's minor order and of the same warm-tinted stone. The classic lines of the exterior are well proportioned and the building is an integral part of the original nucleus with cornice of the same height. In order to incorporate rigidity and freedom from vibration in its construction, Eastman Laboratories were placed on nearly 3,000 piles of reinforced concrete driven into fill and organic silt that rests on a glacial drift of sand. The teak doorway leads into a small lobby lined with Italian travertine decorated with bronze medallions. Across the lobby and opposite the entrance is a lecture hall which was the finest of its kind when built. There are also laboratories, classrooms, a social room, and various special rooms designed to include the most advanced developments in equipment for teaching and research.

In 1938 Bosworth designed the William Barton Rogers Building that completed the great square begun in 1916. Bosworth planned the new building (to continue north from Naval Architecture) as an impressive entrance on Massachusetts Avenue that should proclaim the dignity, the scale, and the academic character of the Institute. Capped by a dome subordinate to the great central dome and enriched with a deep portico, the Rogers Building provides a stately introduction to the grand classic style of the main buildings. Rogers is faced with limestone so that all three buildings on Massachusetts Avenue appear as a single unit. A broad flight of steps leads to a colonnade of four massive Ionic columns and a parallel row of four engaged columns set between the entrance doors and the grillwork of the façade. Within the building, the formal character of Rogers is intensified by the size

(*Concluded on page 326*)

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## *A Report*
## TO M.I.T. MEN

In 1917 Walker Memorial Building was opened, a gift from Alumni for the welfare of M.I.T. students. In addition to including offices for student activities and serving as a student social center, this building houses the dining service.

In 1952-53 nearly one million meals were served to staff and students and 57 dances, receptions and balls were held in Morss Hall. Morss Hall seats approximately 500 people. Thus, each chair served 2,000 people per year or 5.5 persons per day. We thank the Alumni for making these services possible.

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## ARCHITECTURE OF M.I.T.

*(Concluded from page 324)*

and simplicity of a lobby whose height extends more than four floors to the dome. This lobby is surrounded with six tall Ionic columns that emphasize its spaciousness, for the area has been left completely free of details that would reduce its monumental effect. Main corridors extend east and south to the older buildings that are all joined to the later additions in unbroken sequence.

It is not inappropriate that the Rogers Building should be occupied by the School of Architecture and Planning. Since it was established in 1865 at the request of President Rogers as the earliest school of its kind in the country, this School played a distinguished role in education. Its library (The Arthur Rotch Memorial Library), situated on the second floor, is uncommonly well planned, incorporating in its alcove arrangement and open shelves a scheme that is happily adapted to its purpose. In designing the Rogers Building, Bosworth was assisted by Harry J. Carlson as associate architect.

Since 1908, when it built a wind tunnel to investigate the extraordinary possibilities of flight by mechanical airplanes, M.I.T. has always taken a prominent part in research and teaching in the field of aeronautical engineering.

Just 20 years after the first M.I.T. wind tunnel was built, a separate building was constructed with special facilities for instruction and experimentation in aeronautics. The cost was met by a grant from the Daniel Guggenheim Fund for the Promotion of Aeronautics. The architect, Carlson, placed the building north of those on Massachusetts Avenue and in direct line with them so that it could eventually be connected by an intervening structure. The Daniel Guggenheim Aeronautical Laboratory building faithfully follows Bosworth's classic style, and forms a far-flung wing to the buildings extending along Massachusetts Avenue. In addition to drafting rooms and classrooms, the building includes highly specialized facilities, such as a wind tunnel, laboratories for engineering work, and a library.

With the construction of the Aeronautical Laboratory the "Classic Age" at M.I.T. drew to a close, but it closed one building too soon for there is still a break in the long façade between Rogers and Aeronautics on Massachusetts Avenue.

*Part II of Miss Shillaber's article, on the new era in architecture at M.I.T., will appear in the May Review.*

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The "hairpin in a bottle" that burned for 40 hours in Edison's laboratory in 1879 was far more than a better light than the world had yet known. It was also the starting point for the electric utility industry, the electrical manufacturing and the electrical construction industries, that make it possible for electricity to serve us today.

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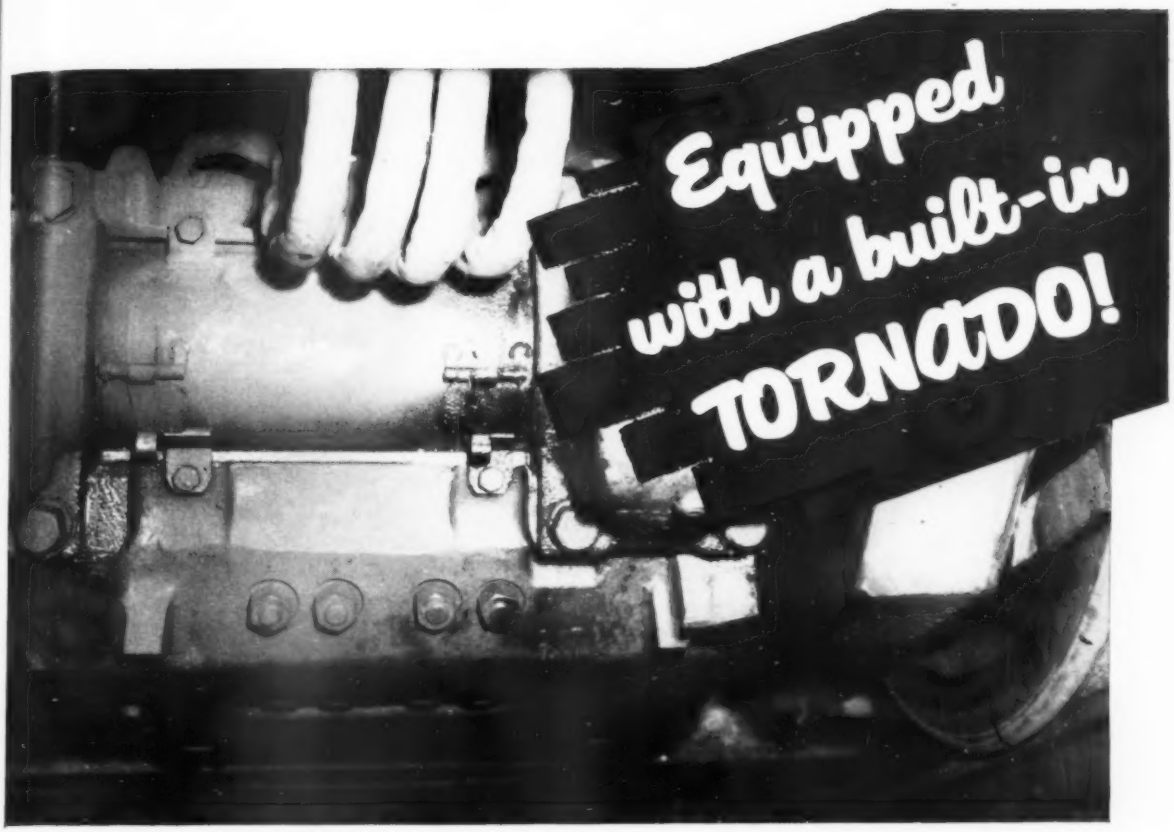



**That's the way a traction motor cable might describe a diesel electric locomotive.** The cable gets sand, ice crystals, snow, water, dirt and debris blasted at it by train suction. The cable is subject to constant vibration and swaying in extremes of temperature both summer and winter.

No wonder, then, that those concerned with diesel locomotive availability insist on the highest quality cable available. That's why the sales curve for Simplex Diesel Locomotive and Traction Motor Cable is going up so steeply. The word has gotten around that you can depend on Simplex Cables. They will be in there pitching long after less rugged cables have been replaced.

Simplex Diesel Locomotive Cables are made to keep locomotives on the road earning money, not in the shop being rewired. If you have any doubt about the ability of your present cable to "take it," try Simplex Diesel Locomotive Cables. You will be surprised and pleased with the service you get from them.

Want to know more about these tough, rugged cables? Your Simplex representative will be glad to tell you about them.

*Simplex*
**DIESEL LOCOMOTIVE CABLE**

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Massachusetts

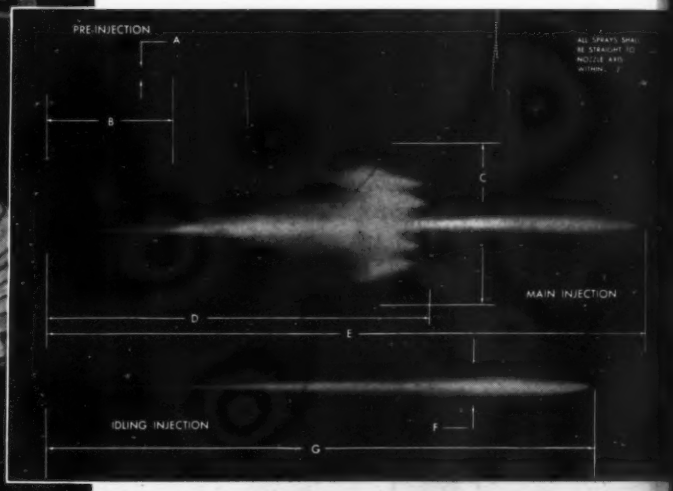
# "Every Nozzle of this type produced by us is tested with the G-R Strobotac and Strobolux"

**American Bosch Corporation** of Springfield, Massachusetts, leading producer of Diesel fuel injection equipment, uses the G-R STROBOTAC* and STROBOLUX* for 100% inspection of their pintle-type injection nozzles.

**They say:** — *"For efficient operation, high-speed Diesel engines require not only accurate fuel distribution in each cylinder, but also a nozzle spray which must have a precise pattern during its development in the combustion chamber.*

*We use the STROBOTAC and the STROBOLUX to test every nozzle of this type before shipment. Each spray is 'stopped' at various points during its development to evaluate its preinjection, shape, penetration and direction. These spray patterns are checked against master spray charts.*

*The photograph shows an Inspector checking the spray characteristics of our pintle-type injection nozzle."*




One of the Master Spray Pattern Charts against which American Bosch Diesel nozzles are inspected at various points during development of the spray pattern.

Photos Courtesy American Bosch Corporation

You may not be a Diesel manufacturer. Possibly you are not even interested in Diesel engines . . . but this experience of another of the thousands of users of G-R stroboscopic equipment may suggest an application to your processes which can assist you in research, design, manufacture and inspection of your product.

Inexpensive, accurate, easy-to-use and portable, these stroboscopes have been of inestimable value and have opened many new fields in the inspection of rapidly moving accessories in mechanical and electro-mechanical design and production.

We have just published a new Stroboscope Bulletin which describes all G-R stroboscopes and suggests many applications for them. We will be glad to send you a copy. Just fill in the coupon below.

* T. M. Reg. U. S. Pat. Off.

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